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TECHNICAL REPORT 8806

BIOLOGICAL TREATMENT OF COMPOSITION B WASTEWATERS

II. ANALYSIS OF PERFORMANCE OF HOLSTON ARMY AMMUNITION PLANT WASTEWATER TREATMENT FACILITY, JANUARY 1985 THROUGH AUGUST 1986

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Prepared for

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY
ABERDEEN PROVING GROUND, MD 21010-5401

by

U S ARMY BIOMEDICAL RESEARCH & DEVELOPMENT LABORATORY

Fort Detrick

Frederick, MD 21701-5010

August 1988

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REPORT DOCUMENTATION PAGE

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1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			7a. NAME OF MONITORING ORGANIZATION		
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Biomedical Research and Development Laboratory		6b. OFFICE SYMBOL (if applicable) SGRD-UBG-O	7b. ADDRESS (City, State, and ZIP Code)		
6c. ADDRESS (City, State, and ZIP Code) Fort Detrick Frederick, MD 21701-5010			9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Technical Report 8806		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Toxic and Hazardous Materials Agency		8b. OFFICE SYMBOL (if applicable) AMXTH-TE-D	10. SOURCE OF FUNDING NUMBERS		
8c. ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground MD 21010-5401		PROGRAM ELEMENT NO. 62720A	PROJECT NO. 1L62720	TASK NO. DQ48	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Biological Treatment of Composition B Wastewaters - II Analysis of Performance of Holston Army Ammunition Plant Wastewater Facility, January 1985 thru August 1986					
12. PERSONAL AUTHOR(S) W. Dickinson Burrows; Elizabeth T. Paulson; Robert P. Carnahan					
13a. TYPE OF REPORT Technical Report		13b. TIME COVERED FROM Jan 86 to Dec 87		14. DATE OF REPORT (Year, Month, Day) 1988, August 18	
15. PAGE COUNT 67					
16. SUPPLEMENTARY NOTATION					
17. COSAT CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Composition B; Anoxic Filter; RDX; Water Treatment		
			Explosives; Activated Sludge; HMX; Water Filtration		
			Wastewater; TAX; SEX (CT)		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>The U.S. Army Biomedical Research and Development Laboratory has conducted a study of the operation of the industrial liquid waste treatment facility at Holston Army Ammunition Plant (HSAAP) from startup in 1983 through August 1986. The HSAAP waste treatment plant includes anoxic denitrification filters, a trickling filter, activated sludge treatment, and dual media filtration, and currently receives about 5 mgd of process wastewaters containing moderate chemical oxygen demand and nitrate levels and low, but significant, levels of RDX, HMX and nitramine coproducts. Daily performance and operational parameters have been compiled and analyzed, and the overall efficiency of the treatment scheme has been evaluated. It is concluded that this treatment facility is adequate for HSAAP for the foreseeable future, but does not represent the best choice for a new RDX facility elsewhere. <i>Key words: hazardous materials</i></p>					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL W. Dickinson Burrows, Ph.D., P.E.			22b. TELEPHONE (Include Area Code) (301) 663-2446		22c. OFFICE SYMBOL SGRD-UBG-O

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PREFACE

This study has been performed under R&D Project No. 1L162720D048, US Army Toxic and Hazardous Materials Agency, and is part of the Army Materiel Command Pollution Abatement and Environmental Control Technology Program. Project Officer is Janet Mahannah. The authors gratefully acknowledge the assistance of Holston Army Ammunition Plant and Holston Defense Corporation personnel in preparing this report. We note in particular the contribution of Patricia Marsack Evans, who patiently answered endless questions on details of plant operations and who responded promptly and cheerfully to repeated requests for more data. Johnny Ray Evans and Mike Mills also gave generously of their time. Much of the field data was collected by Mark O. Schmidt, and all nitramine analyses were performed by Ernst E. Brueggemann, both of the US Army Biomedical Research and Development Laboratory (USABRDL).

Elizabeth T. Paulson was a student at West Virginia University under contract to USABRDL during the period of performance of this study. The services of Robert P. Carnahan, University of South Florida, were retained under the Intergovernmental Personnel Act of 1970.

INTRODUCTION

In early 1985, the U.S. Army Biomedical Research and Development Laboratory (USABRDL), at that time the U.S. Army Medical Bioengineering Research and Development Laboratory, undertook an evaluation of performance of the major unit processes of the Holston Army Ammunition Plant (HSAAP) wastewater treatment facility. It is understood that this evaluation will provide guidance for selection of appropriate technologies for treating wastewaters at a projected new RDX manufacturing plant (X-Facility); it is not intended as a critique of the present HSAAP treatment facility.

To the best of our knowledge, all relevant documented operational and performance data from June 1983, the date of initial startup, through August 1986 were collected. Additional parameters were measured as deemed necessary through grab samples, and periodic readings were taken from various gauges in the treatment plant control room. Facility specifications were obtained from the design calculations of Clark, Dietz and Associates,¹ and operational practices were learned through frequent discussions with personnel at Holston Defense Corporation (HDC), the operating contractor. At least one individual from BRDL was on site at HSAAP continuously from June 1985 through August 1986. After preliminary examination of the data, it became apparent that stabilized operation of the wastewater treatment plant was achieved near the end of 1984; we therefore have chosen to evaluate in detail the 20 months of operation from January 1985 through August 1986.

In evaluation of the HSAAP wastewater treatment facility, two important aspects of the ammunition plant must be understood. First, HSAAP is not a continuous production facility as such; RDX is made in a continuous process, but HMX is made in a batch process. There are as many as 60 different products, and while nearly all incorporate RDX or HMX, the manufacturing processes and hence the wastes generated (spent solvents, e.g.) can be quite variable. In this respect, HSAAP resembles a fine chemicals manufacturer. Second, the present wastewater treatment plant was designed to treat a wastewater that it has not encountered. All process design research presumed a level of water conservation yet to be practiced in production. Thus, the present wastewater treatment plant, constructed to accommodate 50 percent of the projected full mobilization wastewater average discharge of 12.7 mgd (15 mgd maximum), already is handling an average of 6 mgd with production at approximately 16 percent of full mobilization capacity. The combined wastewater is therefore substantially weaker with respect to most parameters than was envisioned when the plant was designed. (It is not anticipated that an increase in production will result in a proportionate increase in wastewater discharge; a substantial fraction of the present flow, such as infiltration, is independent of the level of production.²) In evaluating individual unit processes, we have documented and evaluated performance in terms of the actual applied wastes, but we have also speculated on the performance that might be expected with the more concentrated wastes.

DESCRIPTION OF FACILITIES

The combined wastewater treatment plant receives three separate wastestreams. The largest of these, approximately 4 mgd, contains the production wastes from Area B, as well as some storm run-off from both active and inactive production facilities. Area A wastewaters, approximately 0.5 mgd, are transported 5 miles from Kingsport, TN, by pipeline. An additional 0.5 mgd is settled filter backwash from the river water treatment plant. This latter stream, like storm run-off, is significant in that it imposes a hydraulic burden on the biological treatment plant, but very little waste burden. The manufacturing operations are described by Hash, Evans and Simerly as follows:

Area A

1. Azeotropic distillation to concentrate dilute acetic acid to 99+ percent purity. Acetic acid is used in explosives manufacture and in the production of acetic anhydride.
2. Thermal dehydration of concentrated acetic acid to produce ketene as an initial step in acetic anhydride manufacture.
3. Absorption of the ketene to produce crude acetic anhydride and the subsequent recovery of unreacted acetic acid.
4. Refinement of crude acetic anhydride by distillation.
5. Manufacture of producer gas for use as fuel in acetic anhydride production.

Area B

1. Nitrolysis of hexamethylenetetramine (dissolved in acetic acid) using nitric acid/ammonium nitrate, and acetic acid to produce crude RDX and HMX.
2. The recovery of crude RDX from unreacted materials.
3. The recrystallization of RDX and HMX.
4. The production of a variety of explosive compositions, the most notable of which is Composition B, a mixture of RDX, TNT, and wax.
5. The packaging of explosives for shipment.
6. The manufacture and concentration of nitric acid.
7. The recovery of spent acetic acid for refinement at Area A.
8. The recovery of ammonia from the destruction of explosive-contaminated sludges.

As indicated above, the combined wastewater treatment facility was designed for an average flow of 12.7 mgd at 100 percent mobilization (11.5 mgd from Area B), and constructed for half this flow, with a few exceptions.

Daily flows, averaged monthly, to and from the treatment facility are shown in Figure 1 and Table 1 for the period under study. (The settled filter backwash from the river water treatment plant, mentioned above, makes up most of the postthickener overflow.) It will be noted that the plant discharge exceeds the combined individual wastestreams by approximately 8%; it is not known whether this difference results from unidentified water sources, such as infiltration and inflow, or simply represents cumulative errors in flow totalizers. Individual treatment units, diagrammed in Figure 2, are as follows:

1. Preliminary (Explosives) Settling Basins
2. Neutralization Basins
3. Anoxic Filters
4. Aerobic (Trickling) Filter
5. Aeration Basins
6. Secondary Clarifiers
7. Multimedia Filters
8. Prethickener
9. Aerobic Digesters
10. Postthickeners
11. Filter Presses

For the most part, routine operational details for these units are adequately discussed in U.S. Army Environmental Hygiene Agency Water Quality Engineering Study No. 32-24-6871-85⁴ and will not be repeated here.

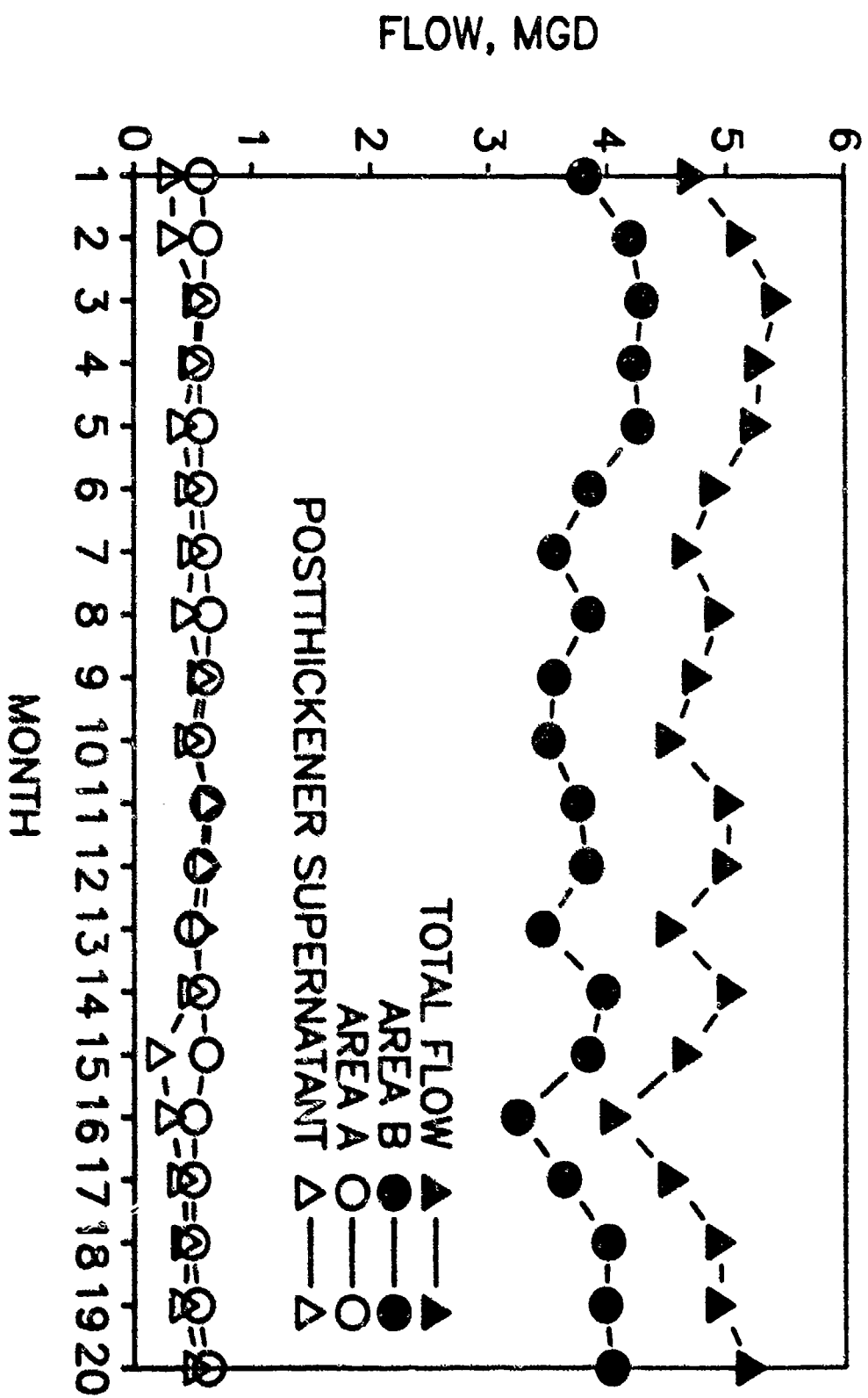


Figure 1. Monthly Average Wastewater Discharge, 1 Jan 85 - 31 Aug 86.

TABLE 1. HSAAP WASTEWATER FLOWS, MGD

Month	Area A	Area B	Postthickener supernatant	Total	Plant discharge
JAN 1985	0.571	3.816	0.329	4.716	5.406
FEB 1985	0.606	4.195	0.334	5.135	5.895
MAR 1985	0.591	4.294	0.545	5.430	5.898
APR 1985	0.545	4.229	0.511	5.285	5.609
MAY 1985	0.572	4.259	0.417	5.248	5.573
JUN 1985	0.568	3.855	0.481	4.904	5.166
JUL 1985	0.603	3.559	0.502	4.664	5.146
AUG 1985	0.646	3.845	0.451	4.942	5.292
SEP 1985	0.617	3.553	0.578	4.748	5.045
OCT 1985	0.547	3.508	0.475	4.530	4.813
NOV 1985	0.613	3.754	0.650	5.017	5.453
DEC 1985	0.563	3.825	0.614	5.002	5.557
JAN 1986	0.490	3.460	0.583	4.533	5.000
FEB 1986	0.577	3.963	0.499	5.039	5.444
MAR 1986	0.607	3.835	0.224	4.666	5.123
APR 1986	0.511	3.243	0.308	4.062	4.408
MAY 1986	0.502	3.633	0.412	4.547	4.835
JUN 1986	0.498	4.003	0.445	4.946	5.167
JUL 1986	0.539	3.979	0.428	4.946	5.069
AUG 1986	0.626	4.035	0.538	5.199	5.108

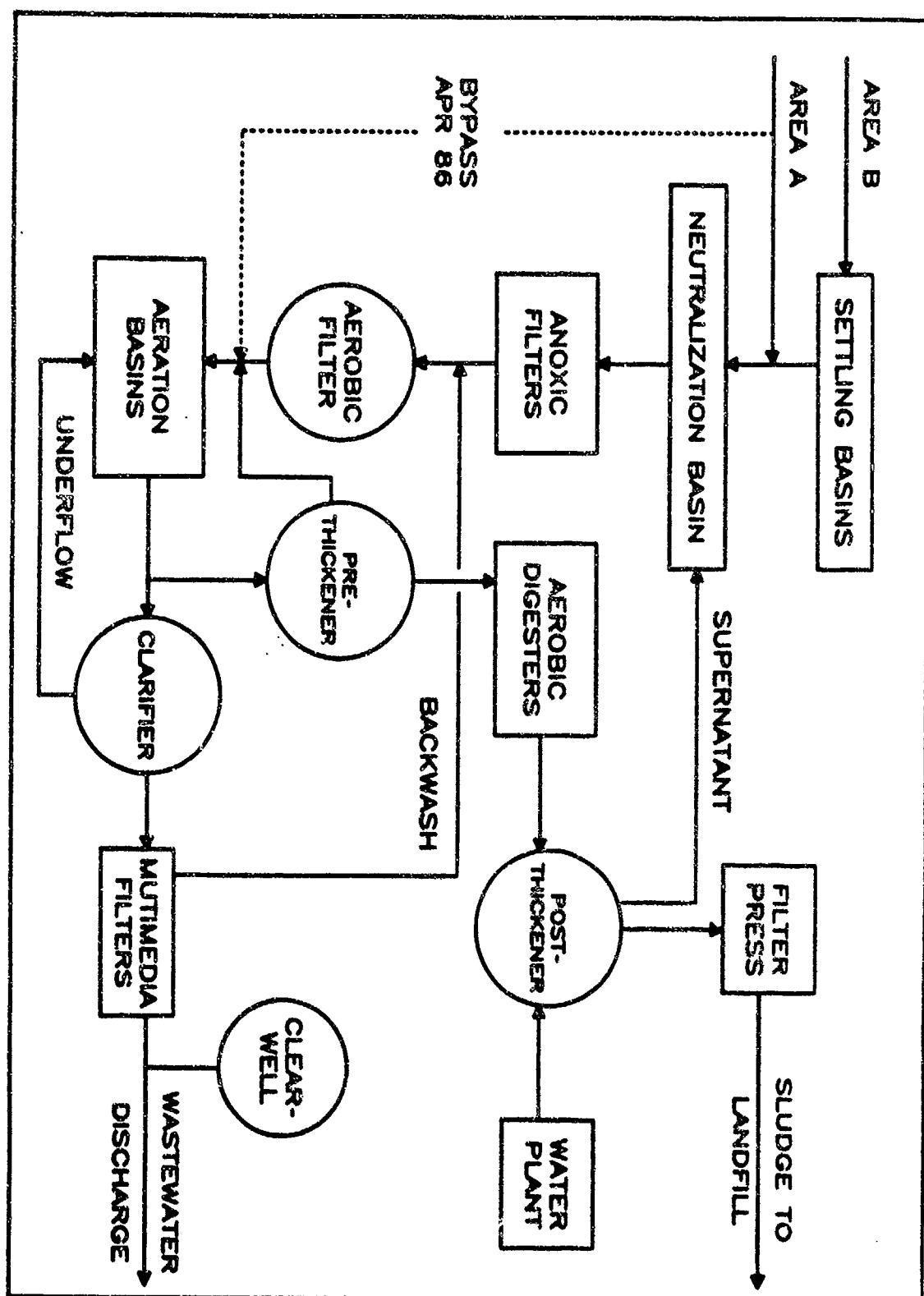


Figure 2. Schematic of HSAAP Wastewater Treatment Facility.

DISCHARGE CRITERIA

The National Pollutant Discharge Elimination System (NPDES) effluent limitations and monitoring requirements are presented in Appendix A. Those parameters that relate to performance of the wastewater treatment plant are listed in Table 2.

TABLE 2. PARTIAL LIST OF NPDES DISCHARGE CRITERIA

Parameter	kg/day (lb/day)		mg/L ^a	
	average	max.	average	max.
BOD ₅ (May 1 - Oct 31)	367 (810)	755 (1620)	19.4	38.8
BOD ₅ (Nov 1 - Apr 30)	551 (1215)	1100 (2430)	29.1	58.3
Total suspended solids	227 (500)	454 (1000)	12.0	24.0
Total N (May 1 - Oct 31)	175 (385)	354 (780)	9.2	18.7
Total N (Nov 1 - Apr 30)	272 (600)	354 (780)	14.4	18.7
NH ₃ -N (May 1 - Oct 31)	45 (100)	91 (200)	2.4	4.8
NH ₃ -N (Nov 1 - Apr 30)	91 (200)	136 (300)	4.8	7.2
Total phosphorus	97 (213)	97 (213)	5.1	5.1

a. Concentration in mg/L calculated for current average 5 mgd discharge.

SAMPLING AND ANALYSIS

All data for wastewater contaminant concentrations and SVIs reported by Holston Defense Corporation are based on grab samples collected at each shift (three times per day) except for BOD values, which are taken from composite samples. Analyses were conducted according to Standard Methods.⁶ (BRDL personnel shared the laboratory at the wastewater treatment plant with the analysts, and can attest to the care with which this work was performed.) Flow data are taken from totalizers. Grab samples for nitramine analysis were collected by BRDL personnel and kept refrigerated until flown to Fort Detrick for HPLC analysis according to the method of Brueggemann.⁶

It should be noted that discharge from the postthickeners to the neutralization basin is not continuous; periodic surges from this source (and perhaps others) account for some of the wide variability observed for parameters measured at the neutralization basin and elsewhere.

UNIT PROCESS EVALUATION

Preliminary (Explosives) Settling Basins

Preliminary settling basins consist of two parallel rectangular tanks, 190 ft long, 25 ft wide and 10 ft deep, with sludge collectors. These tanks are intended to remove settleable materials, in particular explosive chemicals, from Area B wastewaters. In practice, precipitation of solids has been much less than the projected 2000 lb/day for full mobilization, and the explosive chemical content is too low to allow open burning of the sludge. In order to avoid processing the sludge, which would probably be restricted to a Class A landfill, HSAAP allows the raw wastewaters to pass through the basins without sedimentation, thereby adding a small burden of solids (no more than 20 mg/L) to the biological treatment system. From June 1985 through August 1986 the munitions chemicals in Area B wastewaters, with the possible exception of HMX, were never observed to approach their solubility limits. Thus, the preliminary settling basins are irrelevant to operation of the HSAAP wastewater treatment plant, and would probably not be needed for X-Facility provided that there are strategically placed traps in production buildings to collect wastewater-borne solid explosives, as there are at HSAAP. The equalization capacity of the basins under current hydraulic loading is only 3.4 hours, so they don't perform a useful function in that regard, either. However, the basins have proved invaluable as surge basins to hold unscheduled dumps or spills at HSAAP; similar spill capacity may be needed for X-Facility.

Neutralization Basins

Neutralization basins were constructed to provide 100 percent, rather than 50 percent, of full mobilization capacity. They consist of two basins with two cells each measuring 13.6 ft by 13.6 ft by 10 ft and high-capacity mixers. Wastewaters are routed through the top basin to the anoxic filters (see below), and overflow from the anoxic filters is routed through the bottom basin. Under the current regime, the hydraulic retention time is 3.9 to 4.4 min/cell, depending on which wastestreams are treated, rather than the design value of 1.4 min/cell. Besides neutralization, the basins provide for addition of nutrients (phosphoric acid, ammonia, and acetic acid) as needed. During the period observed by USABRDL, no chemicals were added; the alkaline postthickener supernatant kept the overall pH at a satisfactory level, and nutrient addition was not considered to be necessary. (We believe, however, that current phosphorus levels are suboptimal for biological treatment of wastewaters, as is discussed later in this report.) Thus, the neutralization basins serve solely as mixing basins for the various waste streams, and it has not been possible to evaluate their intended performance. However, assuming that X-Facility utilizes biological wastewater treatment, the ability to add nutrients and control pH will be required. Nitrate loading to the denitrifiers -- regardless of the type chosen -- will probably be lower for X-Facility, and BOD loading will be higher, so that addition of acetic acid or other carbon supplement should not be necessary. Monthly average chemical oxygen demand (COD) levels at the neutralization basin and other stations within the wastewater treatment plant are presented in Table 3 and Figure 3.

TABLE 3. COD LEVELS IN WASTEWATER TREATMENT PLANT, MG/L

Month	Area A	Neutraliz- ation basin	Anoxic effluent	Act sludge influent ^a	Plant effluent
Jan 1985		245	210		25
Feb 1985		269	249		36
Mar 1985		290	225		30
Apr 1985		260	204		22
May 1985		229	179		29
Jun 1985		247	202		28
Jul 1985		293	250		21
Aug 1985		259	218		20
Sep 1985		277	225		28
Oct 1985		278	229		25
Nov 1985		299	219		27
Dec 1985		308	261		38
Jan 1986		336	293		55
Feb 1986		306	260		48
Mar 1986		297	259		42
Apr 1986	648	212	146	192	33
May 1986	414	191	109	164	27
Jun 1986	290	153	115	141	28
Jul 1986	298	187	133	150	26
Aug 1986	265	173	127	145	22

a. Calculated for period when not identical with anoxic effluent.

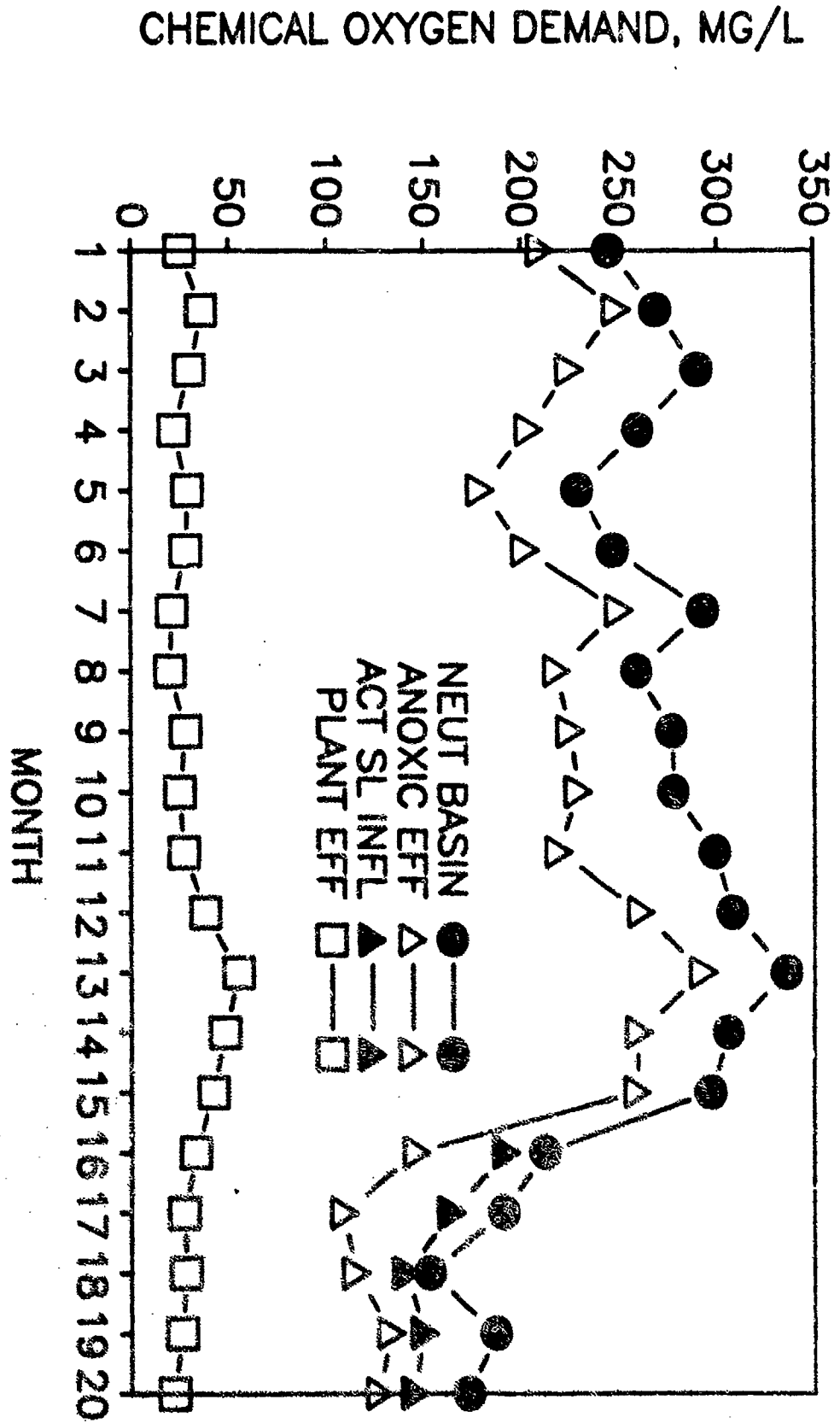


Figure 3. Monthly Average Wastewater COD, 1 Jan 85 - 31 Aug 86.

Anoxic Filters

Design

The anoxic filters consist of four upflow cells each 28 ft by 36 ft in area with a media depth of 10 ft and a liquid depth of 22 ft including the distribution system. Each cell contains corrugated sheet plastic media with a specific surface area of $68 \text{ ft}^2/\text{ft}^3$, close to the minimum recommended by EPA.⁸ The design hydraulic loading is $1.2 \text{ gpm}/\text{ft}^2$; the design waste loading is 3.7×10^{-4} (winter) to 4.1×10^{-4} (summer) $\text{lb}/\text{day NO}_3\text{-N removed per ft}^2$ of packing surface,⁹ compared with a maximum of $1.3 \times 10^{-4} \text{ lb}/\text{day-ft}^2$ recommended by the Environmental Protection Agency (EPA).⁸

Operation

Nitrate loadings are highly variable, as illustrated by daily averages (Appendix C) and monthly averages (Table 4 and Figure 4), owing to the decision of HSAAP to discharge two concentrated nitrate ponds, dating back to the origin of the ammunition plant, through the wastewater treatment system. From startup in 1984 until mid-April, 1986, Area A wastewater was mixed with Area B wastewater and postthickener supernatant in order to take advantage of the strong, degradable Area A wastes in denitrification. Thereafter, through August 1986, Area A wastewater has bypassed the anoxic filters and gone directly to the aeration basins. The hydraulic loading rate has averaged 0.75 to $0.85 \text{ gpm}/\text{ft}^2$ cell surface, depending on whether or not the influent included Area A wastewater, with four cells in service. With three cells in service, which has been the more common practice for reasons given below, the average has been 1.0 to $1.1 \text{ gpm}/\text{ft}^2$. Nitrate concentrations commonly fell in the range of 20 to 40 mg/L for Area B wastewater and 10 to 20 mg/L for the anoxic effluent (Table 4). The average waste loading for the 20-month study period (Table 5) was $1.4 \times 10^{-4} \text{ lb per day per ft}^2$ of packing surface with four basins in service, or $1.9 \times 10^{-4} \text{ lb}/\text{ft}^2\text{-day}$ for three basins.

As the attached biological growth sloughs from the media, heavy particles settle to the bottom of the distribution system to form a sludge layer, while the lighter particles are carried over the weir with the effluent. The sludge is pumped out on a regular schedule. (The design calls for application of the anoxic sludge to the top of the trickling filter, but this is no longer practiced.) Periodically, the attached growth is flushed from the media by concentrating the total flow to a single cell.

Performance

Table 4 presents monthly average nitrate nitrogen levels at various stations within the treatment plant. Nitrate removals have, for the most part, been acceptable but below expectations; there have been occasional excursions above permit limits. The average reduction in nitrate concentration between the Area B wastewater and the plant effluent is 70%, but about 20% results from dilution, and 10% is due to reduction through other processes; the average reduction of nitrate applied to the anoxic filters is slightly less than 50%. The average nitrate nitrogen level in the influent to the anoxic filters during the study period, 21 mg/L , is nearly identical to the design value, but whether because of decreased organic loading or some other reason, this system fails to achieve its design performance of 95%

TABLE 4. NITRATE NITROGEN LEVELS IN WASTEWATER TREATMENT PLANT

Month	Area B mg/L	Neutralization basin (calc ^a) mg/L	Anoxic effl mg/L	Plant effl mg/L
JAN 1985	17	14	13	4
FEB 1985	16	13	12	4
MAR 1985	33	26	13	6
APR 1985	34	27	10	12
MAY 1985	39	32	20	23
JUN 1985	18	14	6	8
JUL 1985	28	21	13	10
AUG 1985	30	23	13	13
SEP 1985	40	30	15	15
OCT 1985	42	33	23	16
NOV 1985	42	31	11	6
DEC 1985	22	17	6	3
JAN 1986	11	8	4	3
FEB 1986	10	8	4	3
MAR 1986	7	5	2	2
APR 1986	20		10	7
MAY 1986	32	29	17	8
JUN 1986	21	19	10	6
JUL 1986	29	26	11	4
AUG 1986	33	20	9	3

a. For the period before Apr 86, the neutralization basin concentration is calculated to be the product of the Area B concentration and flow divided by the total flow; for the period following Apr 86, it is taken to be the same product divided by the sum of the Area B flow and postthickener supernatant.

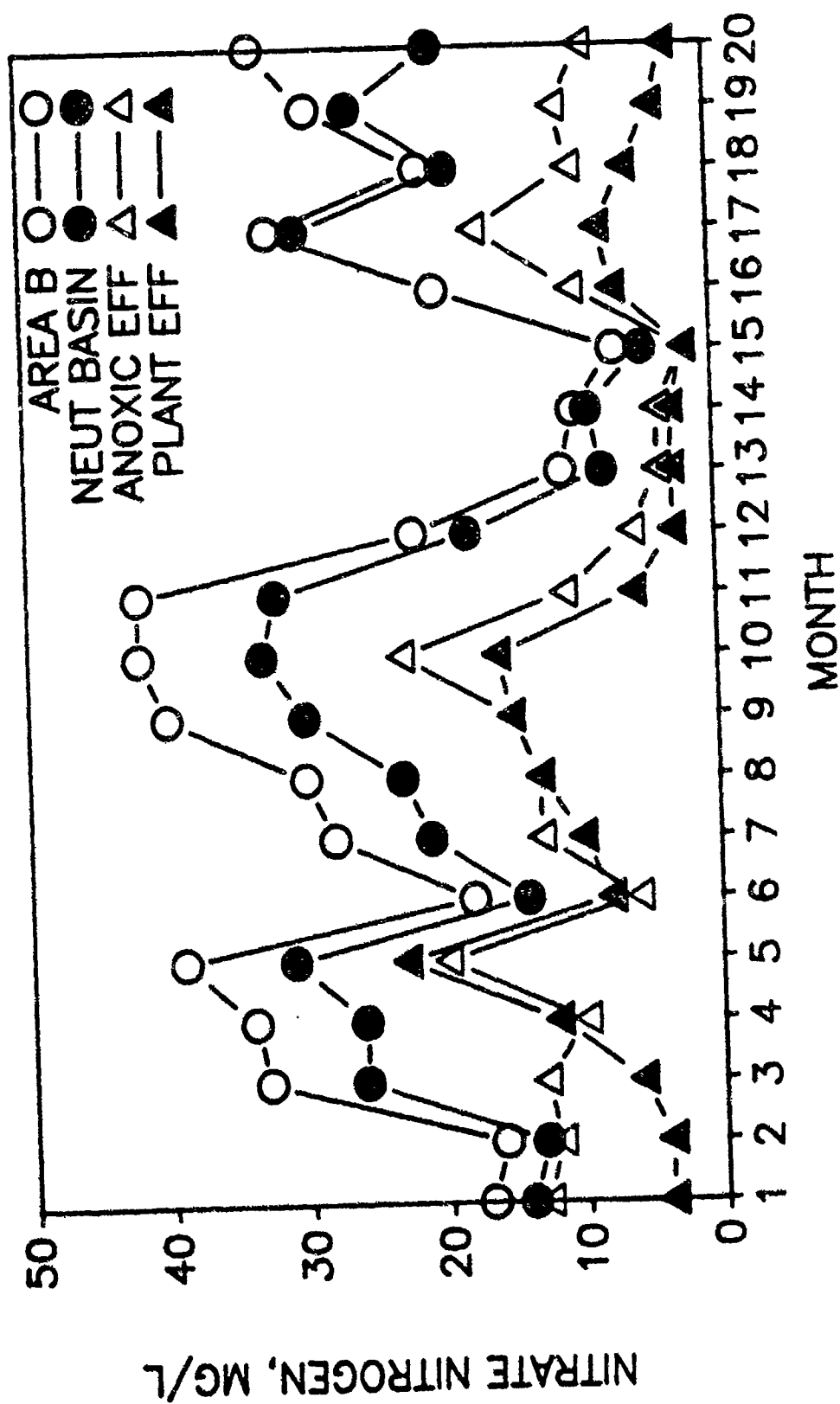


Figure 4. Monthly Average Wastewater $\text{NO}_3\text{-N}$, 1 Jan 85 - 31 Aug 86.

TABLE 5. WASTE LOADING RATES FOR ANOXIC FILTERS

Month	NO ₃ -N removed		Loading rate, 10 ⁻⁴ lb/ft ² -day	
	mg/L	lb/day	4 cells	3 cells
JAN 1985	1	39	0.14	0.19
FEB 1985	1	43	0.16	0.21
MAR 1985	13	589	2.15	2.86
APR 1985	17	749	2.73	3.64
MAY 1985	12	525	1.92	2.55
JUN 1985	8	327	1.19	1.59
JUL 1985	8	311	1.14	1.51
AUG 1985	10	412	1.50	2.00
SEP 1985	15	594	2.17	2.89
OCT 1985	10	378	1.38	1.84
NOV 1985	20	837	3.05	4.07
DEC 1985	11	459	1.67	2.23
JAN 1986	4	151	0.55	0.74
FEB 1986	4	168	0.61	0.82
MAR 1986	3	117	0.43	0.57
APR 1986 ^a				
MAY 1986	12	405	1.48	1.97
JUN 1986	9	334	1.22	1.62
JUL 1986	15	551	2.01	2.68
AUG 1986	11	420	1.53	2.04

a. Operational parameters were changed during this month.

nitrate removal.⁹ Denitrification is strongly pH-dependent. The optimum is approximately pH 7; however, pH values in the acid range permit denitrification in the presence of dissolved oxygen (DO), while anaerobic conditions are essential for denitrification in alkaline solution.¹⁰ In spite of the absence of pH control, the neutralization basin pH varies between 6 and 8 with little diurnal variation, except for brief occasions when discharge of alkaline postthickener supernatant drives the pH to 9 or higher. Lacking ambient DO values for the anoxic filters, we can only guess that pH is not the cause of their poor performance. Although there is no firm correlation between anoxic influent and plant effluent nitrate values, prolonged application of nitrate above 30 mg/L appears to result in permit violations. There is little excess capacity in this part of the system, and a substantial increase in production will necessitate cutting off discharge from the historic nitrate ponds.

The relation between nitrate nitrogen removal and COD removal is given by:⁸

$$\text{COD removed} = 3.71 \times \text{NO}_3\text{-N removed} + 2.3 \times \text{NO}_2\text{-N removed} + 1.3 \times \text{DO}$$

where DO is the dissolved oxygen content of the influent. The DO level in the neutralization basin averaged 3.5 mg/L from January through August, 1986. The only nitrite data we have suggest that nitrite levels in the neutralization basin may be roughly 10% of the total.¹¹ From the data in Tables 3 and 4 it is calculated that the average COD removal over the 20 month observation period exceeded that required for removal of nitrate and DO alone (neglecting any nitrite contribution) by 20%; some of the excess may be due to nitrite removal.

The principal problem in operation of the anoxic filters has resulted from excessive biological growth, uncontrolled by frequent flushing. Over a period of a month or more, depending on the season and nitrate loading (warm weather and high loadings are worst), the growth begins to restrict the wastewater flow; eventually, the media becomes completely plugged, and the blocks of media are displaced and bypassed by the wastewater. The cell must then be taken out of service and the media blocks cleaned with a fire hose, a labor intensive undertaking that eventually destroys the media. During our period of observation, at least one cell was out of service most of the time. The media in one cell was replaced with media from the trickling filter, which has half the specific area and hence bigger passages. (We have not attempted to correct for the corresponding reduced packing surface in Table 5.) This

*Some data concerning performance of the anoxic filters are conflicting. Compositied samples collected during 23 to 30 June 1986 indicated an average nitrate nitrogen removal of 81% in the anoxic filters.¹¹ Grab-samples collected each shift for the same period indicated a removal of 64%. Whether the difference represents a difference in sample treatment or a statistical anomaly is unknown to us.

delayed but did not eliminate the problem, and initial nitrate removal was poorer. Whether this problem results from the high nitrate loading, the low flow rate (resulting in low shear forces), a unique biological growth, or some combination thereof is unknown, and as of August, 1986, no satisfactory solution was in hand. HDC personnel believe that part of the problem can be attributed to a poor wastewater distribution pattern during the flushing cycle. Among recommendations for correcting this problem are increasing the flow rate (hence the shear forces) through effluent recycle, selecting a media with more direct, vertical passages, implementing an air scour system, and placing a screen upstream to intercept occasional large chunks of materials from the manufacturing facility.¹¹ The practice of using spacers to provide vertical separation of approximately 6 inches between media blocks is also worth consideration.

Until the problems in operation of the anoxic filters at HSAAP are resolved, the Army would be poorly advised to duplicate this system for X-Facility. Alternative attached growth systems, such as a totally submerged rotating biological contactor, and suspended growth systems could profitably be evaluated. It should be noted that Carnahan *et al.* have found that the much stronger wastes anticipated by the U.S. Army Armament Research and Development Command for X-Facility cannot be denitrified using upflow anoxic columns.¹²

Aerobic (Trickling) Filter:

Original studies by Grady and Etzel indicated that Area B wastewaters could not be treated by activated sludge because of severe sludge bulking.¹³ Later studies by Hash, *et al.* confirmed the problem with bulking, but indicated that aerobic filters, recommended by Grady and Etzel, could not achieve the effluent quality required.³ Aerobic filters followed by activated sludge were much less susceptible to sludge bulking and provided an acceptable effluent. Both studies used composited production wastewaters amended with appropriate organic compounds (acetic acid, cyclohexanone, acetone, n-butanol, and hexamethylenetetramine) to raise the COD to a level projected for HSAAP combined wastewater following water conservation modifications.

The present aerobic filter system consists of a single natural draft tower 65 ft in diameter with a media depth of 24 ft. The media is corrugated plastic with a specific area of 30 ft²/ft³. The design hydraulic application rate is 1.5 gpm/ft² filter surface, with provision for recycle when the actual flow drops below 0.75 gpm/ft². This system was in operation from June 1983 through August 1984, during which time the hydraulic application rate was approximately 1.0 gpm/ft². The COD application rate cannot be defined for most of this period, but can be estimated to be 110 lb/1000 ft³/day (assuming an anoxic filter effluent COD of 200 mg/L and 400 lb of anoxic sludge wasted per day). These numbers are all near the lower end of the range suggested by EPA for roughing filters.⁸ Aerobic filter effluent values varied widely but commonly fell in the range of 40 to 140 mg/L during the last year of operation (Appendix F). Conservatively, this system achieves 50 percent COD removal, which is appropriate for a roughing filter.

The aerobic filter was removed from service when it became apparent that sludge bulking would not be a problem in the activated sludge treatment system. This decision is estimated by Holston Defense Corporation (HDC) to

have saved \$50,000 a year in pumping costs.⁷ Two circumstances may have made the aerobic filter unnecessary: first, the combined wastewater is little more than half as strong as projected, and second, the anoxic filters, under the high nitrate loading, may be serving as roughing filters. (Biological denitrification, by whatever technology, consumes approximately 4 lb of BOD per lb $\text{NO}_3\text{-N}$ removed). Either of these circumstances could change, and it may become necessary to return the aerobic filter to service in the future. Should it be decided to utilize activated sludge for wastewater treatment at X-Facility, the experience at HSAAP does not provide much guidance concerning the need for a roughing filter. There is no substitute for a pilot study.

Activated Sludge

Design

Based on the studies of Hash, et al., the aeration basins are designed for a mean cell residence time (sludge age) of 8 days and an aeration time of 6 hours.³ They consist of five completely mixed basins (Figure 5) of which four, with a total volume of 1.5 million gallons, were in service during the study period. (During much of 1986 the No. 2 basin was observed to be filled but not under aeration.) Although this complex system has some plug-flow characteristics, we have chosen to treat it as a single completely mixed basin for the purpose of computing performance parameters. Five floating aerators of 60 and 75 hp, providing 200 to 250 hp per million gal, maintained the dissolved oxygen at a more than adequate level of 4 to 6.5 mg/L during the summer months of 1986 in basin No. 3, which receives the heaviest COD loading. Two circular center feed clarifiers, 90 ft in diameter, are fed from a central splitter box. These clarifiers provide a design overflow rate of 565 gpd/ft², or a very conservative 400 gpd/ft² at 5 mgd. (The actual clarifier loading will be roughly 10 percent higher because of recycle of clarified water, such as filter backwash and prethickener freshener.) Sludge collected at the bottom of the clarifiers is returned to the aeration basins by means of screw pumps. Sludge age is controlled by wasting mixed liquors from the splitter box.

Operation

Monthly average operational parameters for the activated sludge system are presented in Table 6. There appear to be no consistent trends other than a significant drop-off in applied COD and volatile solids during the last five months of the observation period. The most important single parameter for operation of an activated sludge system is probably the food-to-microorganism ratio (F/M), in this case calculated as the COD utilized per day divided by the total mass of mixed liquor volatile suspended solids (MLVSS) under aeration, i.e.:

$$F/M = (\text{COD}_{\text{infl}} - \text{COD}_{\text{eff}})/X_{\text{v}}t$$

where $X_{\text{v}}t$ is the concentration of volatile suspended solids (beams) and t is the detention time. Despite the variability in substrate loading and beams, HSAAP has succeeded in maintaining F/M in a relatively narrow range encompassing 0.45 day⁻¹ (Table 6 and Figure 6). This represents the high end for generally accepted F/M levels¹⁴, but it is probably appropriate for such a highly degradable substrate. The average influent of 5 mgd and the present

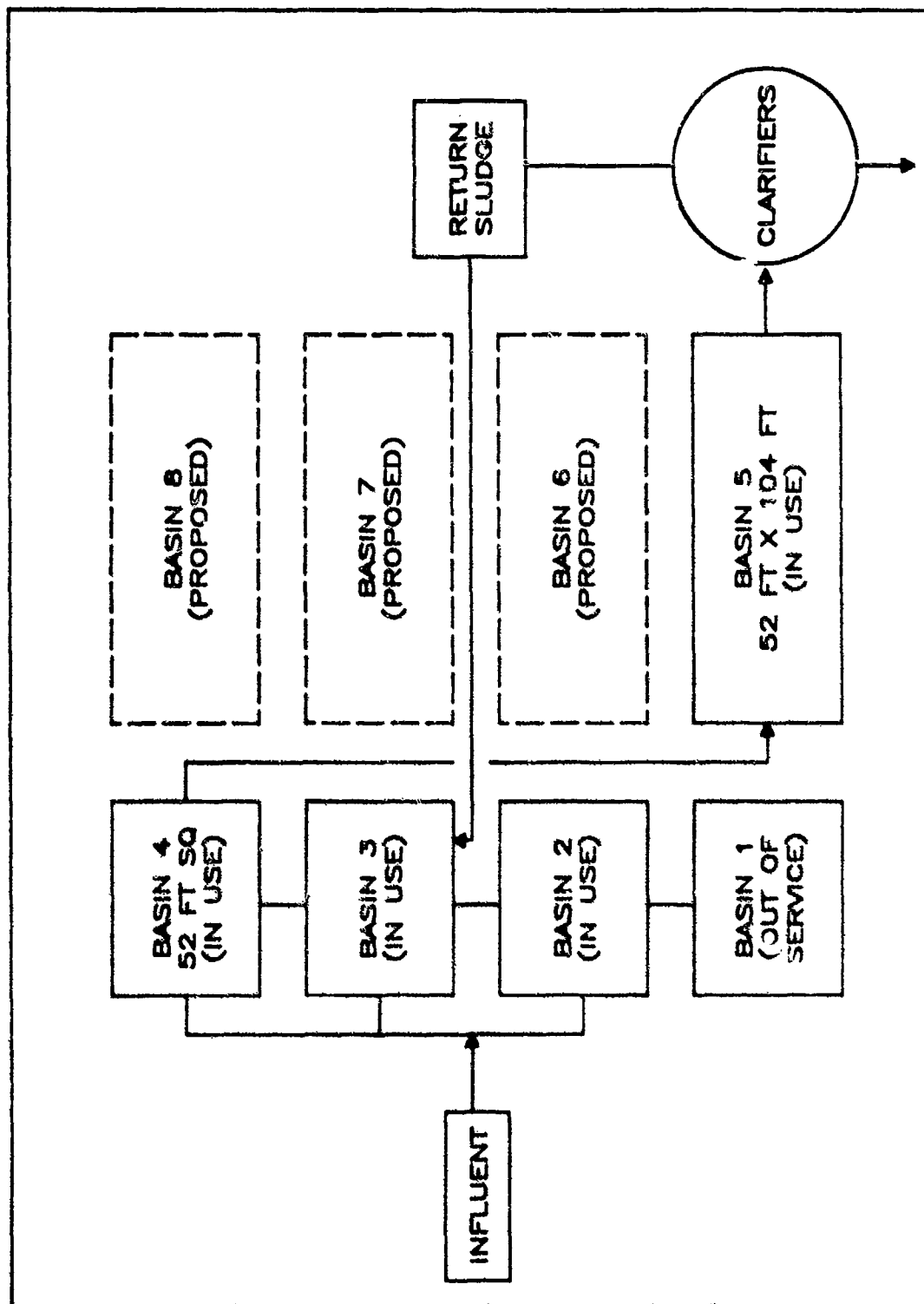


Figure 5. Schematic of Aeration Basins.

TABLE 6. OPERATIONAL PARAMETERS FOR AERATION BASINS

Month	infl COD mg/L	Q mgd	X _y mg/L	t ^a day	θ ^a day	F/M ^a day ⁻¹
JAN 1985	210	4.716	1404	0.318	7.91	0.42
FEB 1985	249	5.135	1643	0.292	8.25	0.45
MAR 1985	215	5.430	1956	0.276	8.69	0.37
APR 1985	203	5.285	1554	0.284	6.76	0.41
MAY 1985	186	5.248	1115	0.286	6.72	0.49
JUN 1985	190	4.904	1061	0.306	7.64	0.50
JUL 1985	250	4.664	1613	0.322	7.50	0.44
AUG 1985	213	4.942	1454	0.304	7.48	0.43
SEP 1985	225	4.748	1274	0.316	7.46	0.49
OCT 1985	235	4.530	1401	0.331	7.44	0.46
NOV 1985	219	5.017	1239	0.299	7.48	0.49
DEC 1985	261	5.002	1485	0.300	7.44	0.49
JAN 1986	293	4.533	1580	0.331	7.44	0.46
FEB 1986	260	5.039	1499	0.298	8.00	0.46
MAR 1986	259	4.666	1622	0.321	9.26	0.41
APR 1986	192	4.062	1269	0.369	8.29	0.34
MAY 1986	164	4.547	1024	0.330	7.64	0.41
JUN 1986	141	4.946	884	0.303	8.17	0.42
JUL 1986	150	4.946	698	0.303	7.65	0.59
AUG 1986	145	5.199	824	0.289		0.52

a. All calculations assume 1.5 million gal. under aeration.

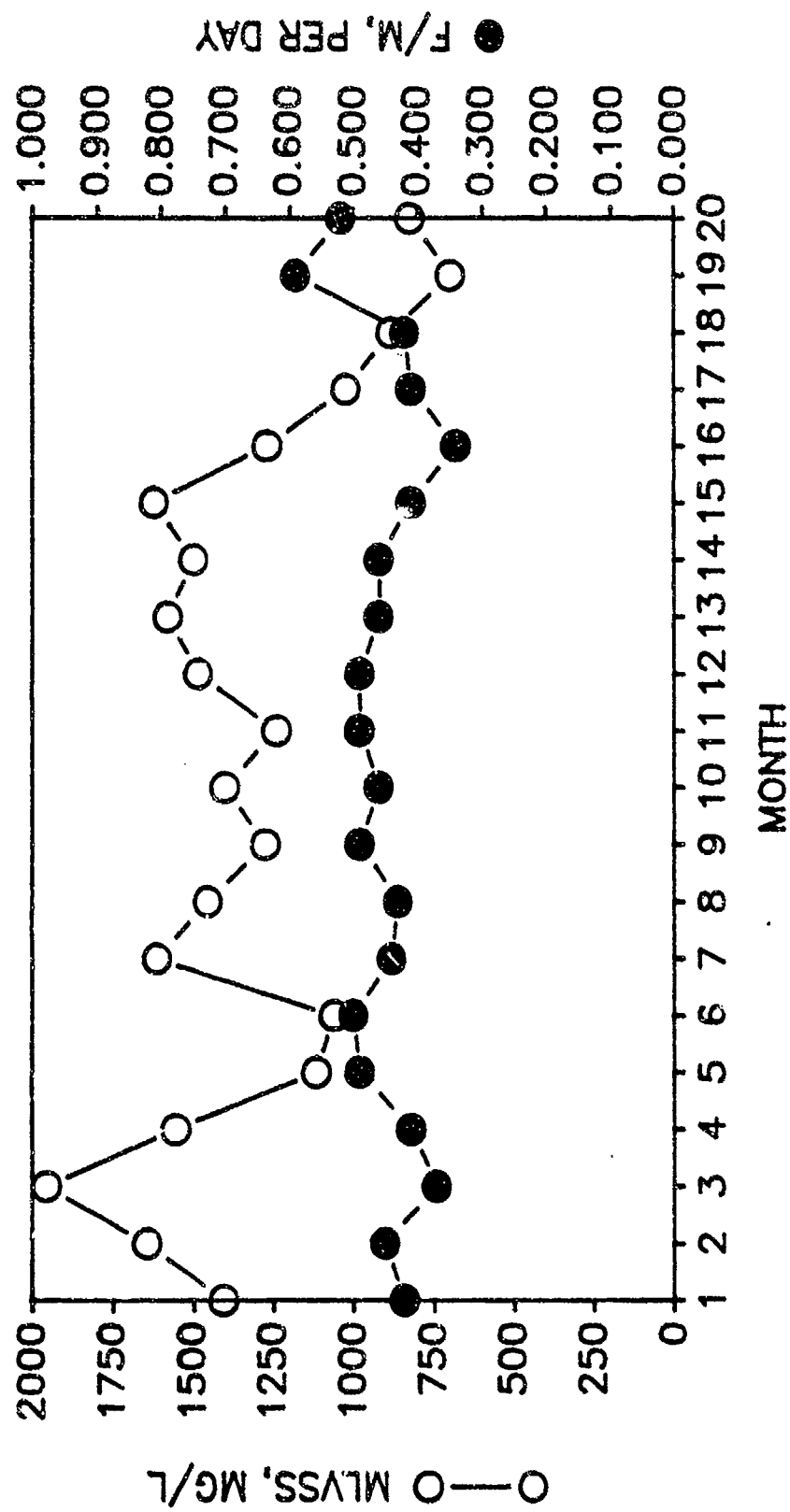


Figure 6. Monthly Average MLVSS and F/M, 1 Jan 85 - 31 Aug 86.

wasting rate of 125 gpm from the basins gives an aeration time of 7.2 hr and a sludge age of 8.4 days; the average values for the 20 months of the observation period have been 7.4 hr and 7.7 days, respectively. These values are within reasonable design limits. Mixed liquor suspended solids have generally fallen in the range of 1500 to 2500 mg/L, of which 65 to 75 percent (occasionally higher) is volatile.

Performance

At an effluent flow of 5 mgd, BOD₅ discharge limitations are 19 and 38 mg/L daily average and daily maximum for May 1 through October 31 and 29 and 58 mg/L daily average and daily maximum for November 1 through April 30 (Table 2). (It is anticipated that discharge limits will be revised when production exceeds 50 percent of capacity.) As shown in Table 7, HSAAP has had no problem achieving these limitations; effluent BOD levels (after filtration) are commonly less than 4 mg/L. Influent COD's from the anoxic filters have been variable, falling in the range 250±100 mg/L (Appendix E); COD removals have consistently exceeded 80 percent. Monthly average COD levels at various stations are shown in Table 3 and Figure 3.

The organic removal rate coefficient, k_{BOD} , is calculated from the equation:¹⁵

$$[S_0(S_0 - S_e)]/X_v t = k_{BOD} S_e$$

where

S_0 = influent total BOD₅

S_e = effluent soluble BOD₅

Lacking influent BOD data for the aeration basins, we have assumed that $S_0 = (COD_{infl} - COD_{eff}) + S_e$; this may slightly underestimate S_0 , but should be sufficiently accurate for our purpose. Effluent BOD values are unusually low, indicating nearly complete utilization of biodegradable substrate, and as a consequence k_{BOD} values are high (Table 7). These results are not unexpected if, as has been suggested,¹⁶ principal organic waste constituents from RDX production wastewaters are formaldehyde and formic acid, with lesser amounts of cyclohexanone, acetone, and acetic acid, *inter alia*. All these compounds are highly biodegradable, and in the case of formaldehyde one cannot eliminate the possibility of substantial chemical degradation through air oxidation. Of the nonbiodegradable portion of the influent COD, 5 to 8 mg/L can be attributed to nitramines, while much of the rest may be due to hexamethylenetetramine (hexamine). Temperature effects on k_{BOD} are predictable, with late summer rates being nearly double late winter rates, corresponding to a difference of approximately 10°C (Appendix J). The anomalous low k_{BOD} for June 1986 is unexplained, but it accompanied the lowest observed influent COD, perhaps during a clean-up period.

Performance with respect to nutrients may be atypical for a chemical plant, since nutrients are not supplemented at HSAAP. Nitrogen and phosphorus requirements for activated sludge are generally taken to be 12.3% and 2.6%, respectively, of the weight of biomass wasted.¹⁵ For an average wastage of 4300 lb/day of biomass (Tables 7 and 8), a 5 mgd wastestream would require nitrogen and phosphorus levels of 12.7 mg/L and 2.7 mg/L respectively. Not all of this needs to be added; some nutrient values are recovered during digestion of the waste sludge (see below) and returned to the head of the

TABLE 7. ACTIVATED SLUDGE PERFORMANCE

Month	Effl COD ^a mg/L	COD removed percent	S _e ^b mg/L	S _o mg/L	k _{BOD} ₁ day ⁻¹
JAN 1985	25	88	1.9	187	41
FEB 1985	36	86	2.6	216	37
MAR 1985	30	87	1.5	196	47
APR 1985	21	90	0.7	183	NC ^c
MAY 1985	29	84	1.4	151	51
JUN 1985	28	86	1.8	176	52
JUL 1985	21	92	1.4	230	72
AUG 1985	20	91	1.1	199	81
SEP 1985	28	88	1.3	198	75
OCT 1985	25	89	0.5	204	NC ^c
NOV 1985	27	88	0.9	193	NC ^c
DEC 1985	38	85	2.5	226	45
JAN 1986	55	81	3.0	241	37
FEB 1986	48	81	4.6	217	23
MAR 1986	42	84	2.7	220	34
APR 1986	33	83	1.2	160	35
MAY 1986	27	84	0.6	138	NC ^c
JUN 1986	29	79	4.1	117	12
JUL 1986	26	83	1.0	125	73
AUG 1986	22	85	1.0	124	64

a. Data taken from samples of plant effluent.

b. Data are for composited samples of plant effluent, taken from Discharge Monitoring Report.

c. Not calculated; the authors consider BOD₅ values <1 to be unreliable for calculating rate constants.

TABLE 8. WASTAGE OF SUSPENDED SOLIDS FROM AERATION BASINS

Month	MLSS mg/L	Mixed liquors wasted		Clarifier solids mg/L	SVI mL/g
		gpd	lb/day ^a		
JAN 1985	1806	189,587	2856	21	65
FEB 1985	1909	181,821	2895	27	81
MAR 1985	2456	172,700	3537	22	110
APR 1985	2063	221,887	3818	10	85
MAY 1985	1616	223,184	3008	16	55
JUN 1985	1492	196,427	2444	13	51
JUL 1985	2416	199,897	4028	14	56
AUG 1985	2279	200,577	3812	15	58
SEP 1985	1742	200,940	2919	12	72
OCT 1985	1948	201,490	3273	11	78
NOV 1985	1599	200,510	2674	10	88
DEC 1985	1792	201,713	3015	15	79
JAN 1986	1775	201,690	2986	21	103
FEB 1986	1747	187,596	2733	20	100
MAR 1986	1921	161,942	2594	15	128
APR 1986	1663	180,089	2509	27	83
MAY 1986	1454	196,358	2381	10	71
JUN 1986	1403	183,650	2149	9	75
JUL 1986	926	196,050	1482	16	47
AUG 1986	1204			10	57

a. Wastage does not include clarifier overflow solids, which are usually removed by filtration and returned in the backwash water to the aeration basins.

plant. A rule of thumb states that for every 100 parts of BOD applied the influent wastewater should contain 5 parts of nitrogen and one part of phosphorus; this would correspond to 9 mg/L and 2 mg/L, respectively, for the stream entering the aeration basins, which has an estimated average BOD level of 187 mg/L for the 20 month period of observation (Table 7). Nitrogen is usually added in the reduced form (ammonia, e.g.), but wastewater at the head of the plant contains very little ammonia nitrogen (commonly less than 1 mg/L), and successful operation of the activated sludge system depends on utilization of nitrate nitrogen, averaging 11 mg/L (Table 4), discharged from the anoxic filters. Some very limited data suggest that the total phosphorus level at the head of the plant is usually less than 1 mg/L. Most of the phosphorus is in the form of boiler water treatment chemicals from Area A, and is biologically unavailable.⁷ A biological wastewater treatment pilot plant (sequencing batch reactor) was operated at HSAAP during the first 8 months of 1986 in parallel with the main plant; great difficulty was encountered in generating an adequate biomass level until a phosphorus supplement was added.¹⁷ While one must acknowledge the success of the activated sludge system in destroying degradable substrate, it is our belief that the HSAAP treatment plant is phosphorus-limited, and that this will become an increasing problem with increasing wastewater strength.

Total suspended solids limitations are 12 and 24 mg/L daily average and daily maximum at 5 mgd (Table 2). With few exceptions, the clarifier effluent solids have averaged <20 mg/L with mixed liquor suspended solids levels of 1500 to 2500 mg/L, so for the most part the dual media filters, discussed below, have not been overloaded. (A temporary increase in clarifier effluent solids can be controlled by polymer addition at the splitter box; this strategy was successfully employed when one of the clarifiers was taken out of service for maintenance and the hydraulic load to the second was doubled.) The sludge volume index (SVI), a measure of solids settleability, is compared with the mixed liquor suspended solids (MLSS) levels for the observation period in Table 8 and Figure 7. SVI values are generally low, indicating good settleability, and they roughly parallel MLSS values.

We conclude that this lightly loaded activated sludge system is performing satisfactorily, even without phosphorus supplement. There have been some problems; sludge returned from the clarifiers at a ratio of 1.7:1 has been only twice as concentrated as the mixed liquors (based on limited BRDL sampling), and never more than 5000 mg/L, about half the usual value for return sludge. During spring and summer of 1986, the volatile solids under aeration fell below 1000 mg/L, even though the COD loading was increased in mid-April by rerouting the concentrated, highly degradable Area A wastewaters directly to the aeration basins. The system appeared at risk of upset; however, in August 1986 the solids level began to recover, perhaps coincident with reduction in the sludge return ratio to 1.0:1. It seems likely that a much higher waste loading and a somewhat higher hydraulic loading could be accommodated by the present system. Whether and at what loading the sludge bulking problem that plagued the pilot studies will reappear is unknown.

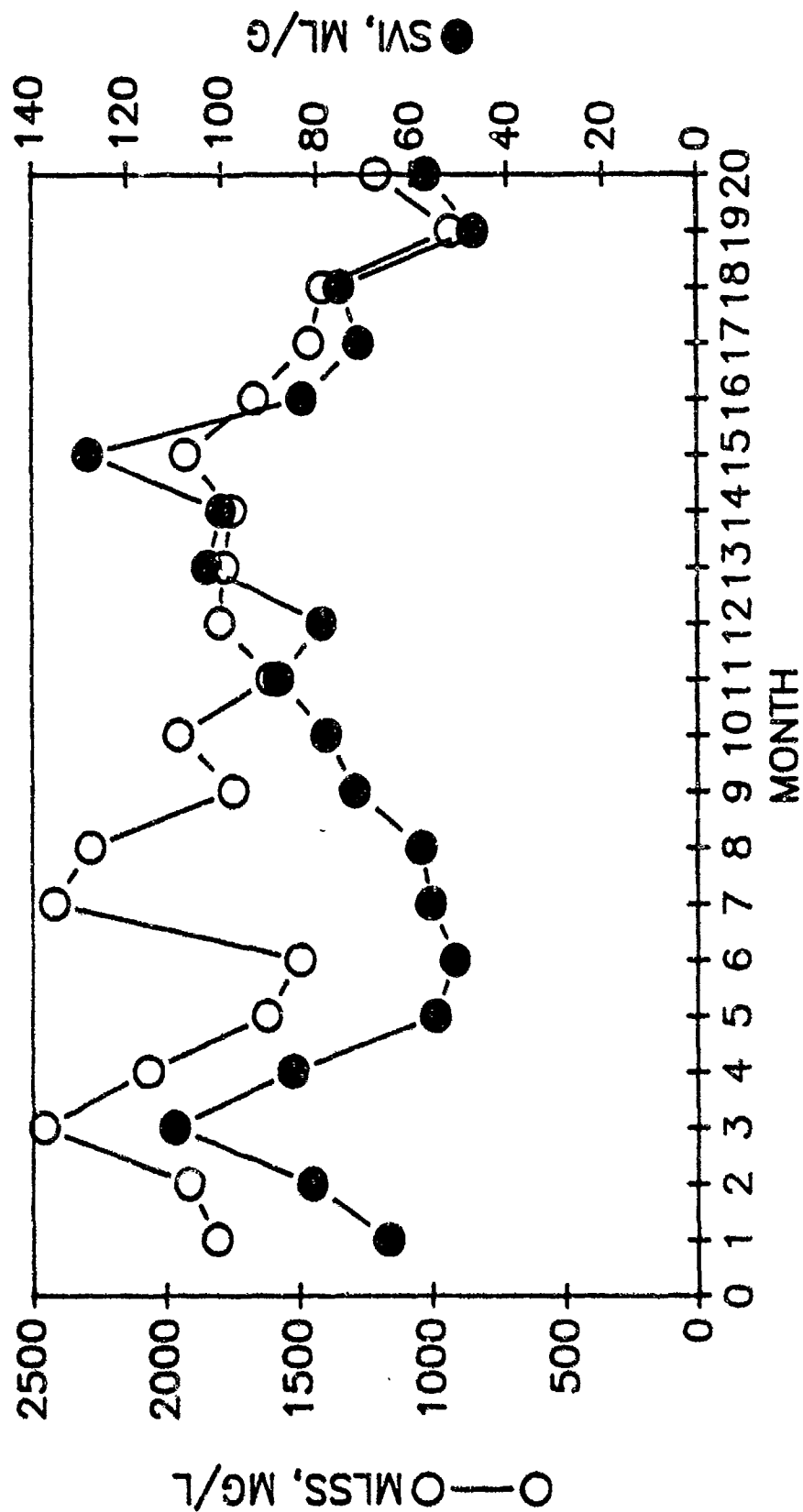


Figure 7. Monthly Average MLSS and SVI, 1 Jan 85 - 31 Aug 86.

Dual Media Filters

Design

The final filtration system consists of four dual media filters (anthracite and sand), each 16 ft 4 in square, a clearwell basin and a backwash tank. The design hydraulic loading is 4 gpm/ft², the design solids capture is 0.69 lb/ft² per run, and the length of each filter run is approximately 23 hours for the design suspended solids removal of 15 mg/L and 10 ft terminal head loss.¹ The backwash water requirement (taken from final effluent in the clearwell) is 65,200 gal/filter/backwash, or 272,000 gal/day for the conditions stated. The backwash water is eventually returned to the aeration basin, so imposes an additional load on the clarifiers. A subsurface agitator, which aids in cleaning the expanded bed during backwash, draws at a rate of about 400 gal/min (during operation) from the river water supply; this increases the effluent discharge relative to the plant influent.

Performance

Filtration for removal of biological solids is troublesome in comparison with removal of suspended silt, e.g., and this system is no exception. However, with the effluent limitations imposed (Table 2), there are no reasonable alternatives, and, everything considered, the system has functioned satisfactorily. Solids removal data for the dual media filters are summarized in Table 9. There is no strong relation between solids removal and backwash volume (Figure 8), but it may be noted that the average solids removal of 590 lb per day for the 20 month observation period, and the average total backwash volume of 86,000 gal/day correspond to a solids capture of 1.7 lb/ft² per run, or nearly 2.5 times the design value. This indicates that the dual media filters are hydraulically limited, and that substantially higher solids loadings could probably be accommodated without degrading performance. (Under the current production schedule, the effluent limitations allow discharge of about one third of the total effluent without filtration, at the option of the plant operator. This may account for the large shift-to-shift and month-to-month variations observed in the suspended solids level of the plant effluent.)

Prethickener

The prethickener, 34 ft in diameter, is designed for a solids loading rate of 4.7 lb/day/ft², a surface overflow rate of 300 gpd/ft², and an underflow solids concentration of 2.5 percent. A typical mixed liquor suspended solids concentration of 1500 mg/L, at a wasting rate of 125 gpm, gives a solids loading rate of 2.5 lb/day/ft² and a surface overflow rate of about 200 gpd/ft². To prevent anaerobic conditions from developing in the prethickener, freshener water is drawn from the clarifier effluent to increase the overflow rate. The prethickener overflow is returned to the aeration basins. The underflow concentration is not measured, but data from the aerobic digesters, described below, suggest an underflow solids level of about 1.7 percent. The prethickener is underloaded; however, there is no reason to believe at this time that it cannot meet its design specifications.

TABLE 9. OPERATION OF DUAL MEDIA FILTERS

MONTH	TSS, plant effluent		Filter backwash gal/day
	mg/L	lb/day removed ^a	
JAN 1985	0.2	938	93,752
FEB 1985	2.6	1200	89,664
MAR 1985	2.6	954	89,026
APR 1985	0.2	458	101,026
MAY 1985	4.8	521	77,187
JUN 1985	3.6	405	81,857
JUL 1985	1.7	528	69,365
AUG 1985	1.4	600	63,597
SEP 1985	1.1	459	68,290
OCT 1985	0.7	413	67,419
NOV 1985	0.3	441	66,320
DEC 1985	0.6	667	64,616
JAN 1986	6.5	621	69,003
FEB 1986	2.9	776	93,929
MAR 1986	2.9	517	108,410
APR 1986	4.6	823	115,813
MAY 1986	1.3	351	108,539
JUN 1986	1.9	306	103,533
JUL 1986	3.5	528	102,510
AUG 1986	1.5	362	

a. Calculation based on "Plant discharge" column, Table 1.

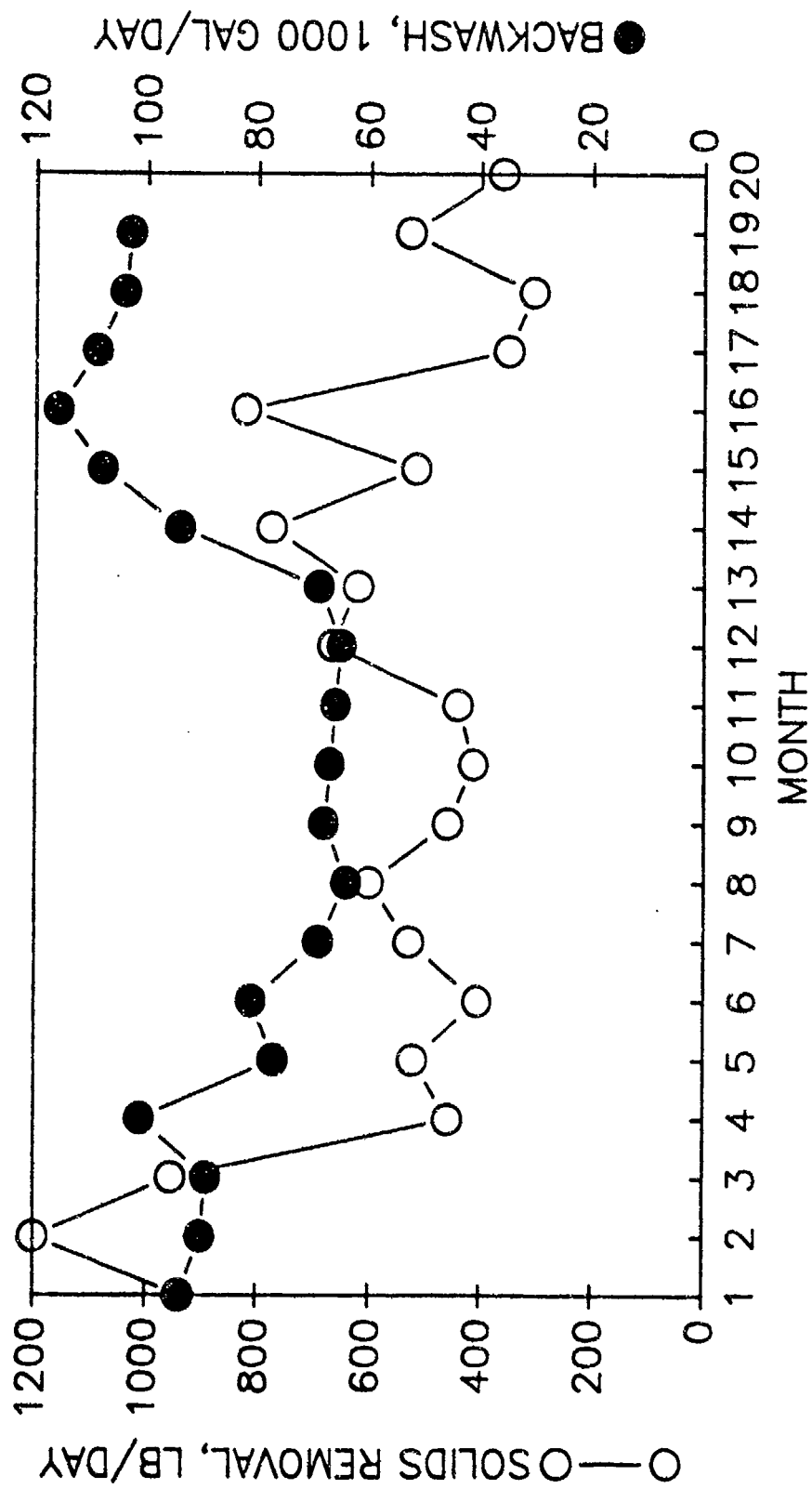


Figure 8. Monthly Average Final Filter Data, 1 Jan 85 - 31 Aug 86.

Aerobic Digesters

Two aerobic digesters, 28 ft by 84 ft in area and 12 ft deep (plus freeboard), have a design combined flow of 20,500 gpd, solids loading of 4,276 lb/day, and a detention time of 20 days. Design calculations assume an oxygen requirement of 2 lb/lb of solids destroyed, an oxygen transfer rate of 2 lb/hp-hr, and 55 percent volatile solids destruction. Limited summer sampling by USABRDL indicates a digester sludge solids concentration of about 11,000 mg/L and a volatile solids concentration of 6000 mg/L, corresponding to 50 percent digestion of volatile solids, assuming that the activated sludge had a volatile solids ratio of 70 percent. The influent to the digesters (i.e., the prethickener underflow) would have had a total solids level of about 1.7 percent, corresponding in turn to a flow of 16,000 gpd and a detention time of 25 days. The aerobic digester, though well underloaded at 2250 lb of solids per day, does not appear to destroy volatile solids as effectively as would be expected. The reasons for this are obscure, since the design is conservative. This has not been a problem, however, since the sludge is readily dewatered in subsequent steps.

Postthickeners

The 100 percent mobilization design calls for four postthickeners: three for alum sludge from the river water filter plant and one for biological sludge from the aerobic digesters. Three have been constructed, each 45 ft in diameter with a liquid depth of 10 ft. The design solids loading rate is 2.67 lb/ft², and the surface overflow rate is 300 gal/day/ft². A freshener stream from the clarifier effluent is available to maintain aerobic conditions in all three postthickeners, but it appears not to have been utilized most of the time. Through May, 1986, the alum and biological sludges were combined. This had the advantage of utilizing excess chemicals from the alum sludge to improve settling in the combined sludge; however, it greatly increased the cost of sludge disposal, since the biological sludge is considered to be a hazardous waste, and the addition of alum sludge more than doubled the total weight. During June, 1986, operations were changed to permit separate dewatering of the sludges. (Delisting of the biological sludge was achieved in December 1986.⁷)

Since most of the solids applied to the postthickeners have been filter plant solids, we cannot quantitatively evaluate the system in terms of its treatment of biological solids. However, dewatering has not been a problem after separation of the sludges, so the system appears to be functioning satisfactorily.

Filter Presses

We do not have design data for the two filter presses. They are basically plate and frame assemblies with cloth filters. Operation has been relatively trouble-free, and a very satisfactory filter cake solids content of 33-35 percent is consistently achieved. The only problem has been that dewatered sludge tends to accumulate around the sludge inlet at the center of each filter plate. If not removed, this accumulation can break the plate in the next cycle. Removal of this accumulation is easily accomplished with a spatula; this adds perhaps 5 to 10 minutes to each cycle.

Filter presses are expensive relative to other sludge filtration systems; capital costs are high, and operational costs for chemicals, namely lime and ferric chloride, are not inconsiderable. However, performance of the units at HSAAP has been generally excellent. Considering that sludge management is commonly the most troublesome aspect of wastewater treatment plant operation, filter presses seem well worth the price for this application.

MUNITIONS DEGRADATION

During the last six months of 1985, nitramine concentrations in the neutralization basin averaged 4.6 mg/L for RDX, 1.8 mg/L for HMX, 2.4 mg/L for TAX, and 1.3 mg/L for SEX; plant effluent concentrations indicated overall removals of 43, 13, 100, and 0 percent, respectively (Table 10 and Appendix L). There is a reduction of about 25 percent in nitramine levels between the Area B influent and the neutralization basin; this is accounted for by dilution from Area A influent and the water treatment plant discharge. Nitramine data for the entire 20 month observation period are limited, but as shown in Figures 9 and 10, there is relatively little variation in influent and effluent concentrations.

For RDX, HMX, and SEX degradation took place exclusively in the anoxic filters; TAX was degraded as well in the aeration basins. However, it should be noted that, for all nitramines except TAX, the final effluent level is actually higher than from the anoxic filters. There are two possible explanations for this: (1) the nitramines are partially reduced in the anoxic filters, then reoxidized in the aeration basins and (2) the nitramines are taken up by the anoxic biomass and released when the biomass is consumed in the aeration basins. Although the first explanation is consistent with the observation by McCormick *et al.* that nitramines are progressively reduced through stable intermediates by anaerobic treatment¹⁸, the second explanation is in agreement with our observation that RDX, HMX, and SEX are sharply reduced in the first stage of an aerobic biodisc, then increase in subsequent stages.¹⁹ We have not observed any substantial signals during the HPLC analysis of nitramines that would correspond to the nitrosamines reported by McCormick *et al.* TNT was not detected in any HSAAP wastewater samples at the detection limit of 0.05 mg/L.

TABLE 10. WASTEWATER NITRAMINE CONCENTRATIONS^a

Station (No. of samples)	Nitramines, mg/L (standard deviation)			
	RDX	HMX	TAX	SEX
Area B Wastewater (34)	6.05 (1.80)	2.24 (0.36)	3.32 (1.64)	1.71 (0.71)
Neutralization Basin (48)	4.57 (1.65)	1.76 (0.33)	2.38 (1.14)	1.35 (0.53)
Anoxic Filter Effl. (34)	1.28 (0.86)	0.98 (0.53)	1.52 (0.87)	1.11 (0.95)
Final Plant Effl. (36)	2.62 (0.50)	1.54 (0.26)	<0.07	1.42 (1.17)

a. Samples collected from July through December 1985

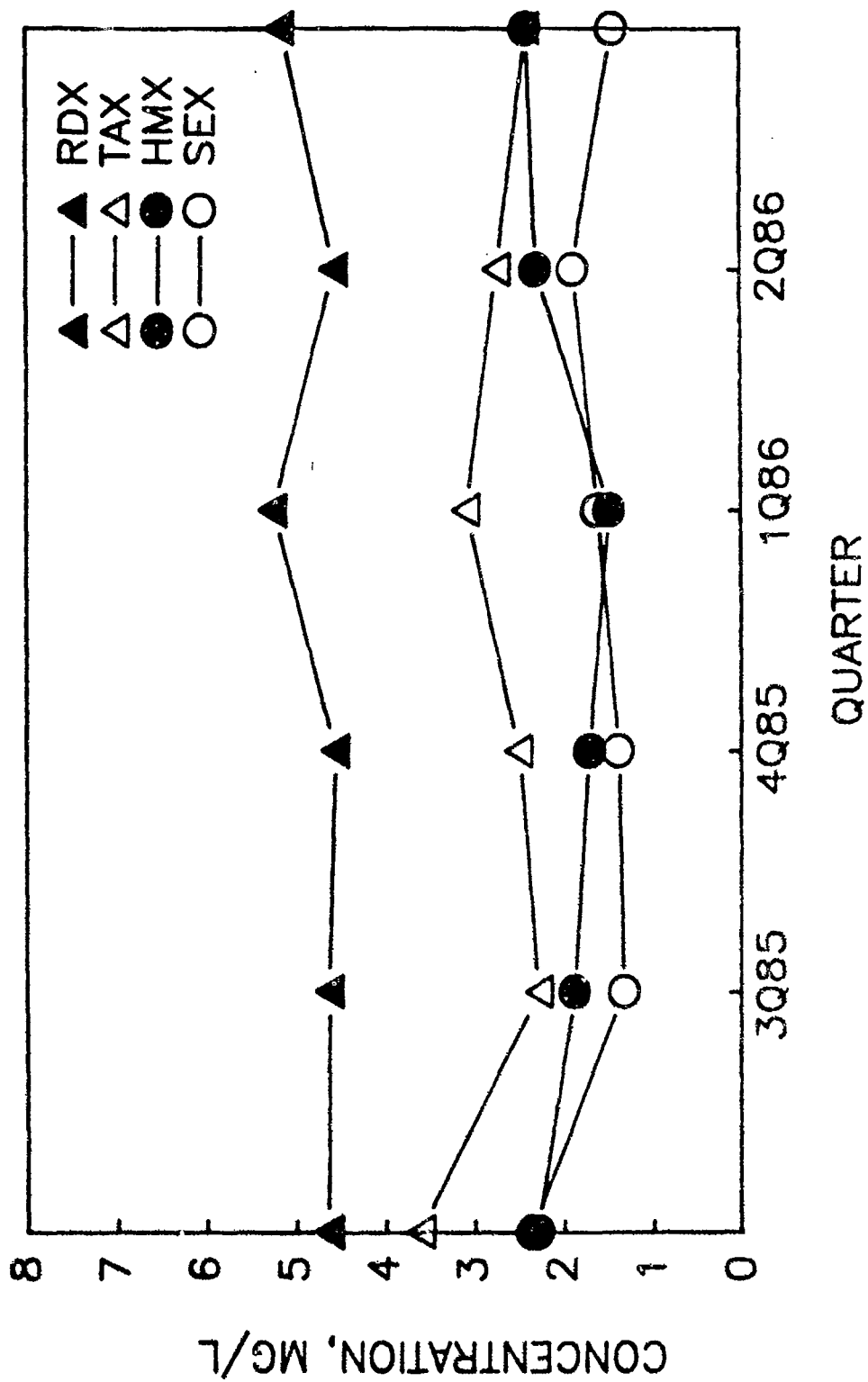


Figure 9. Quarterly Average Nitramines, Neutralization Basin.

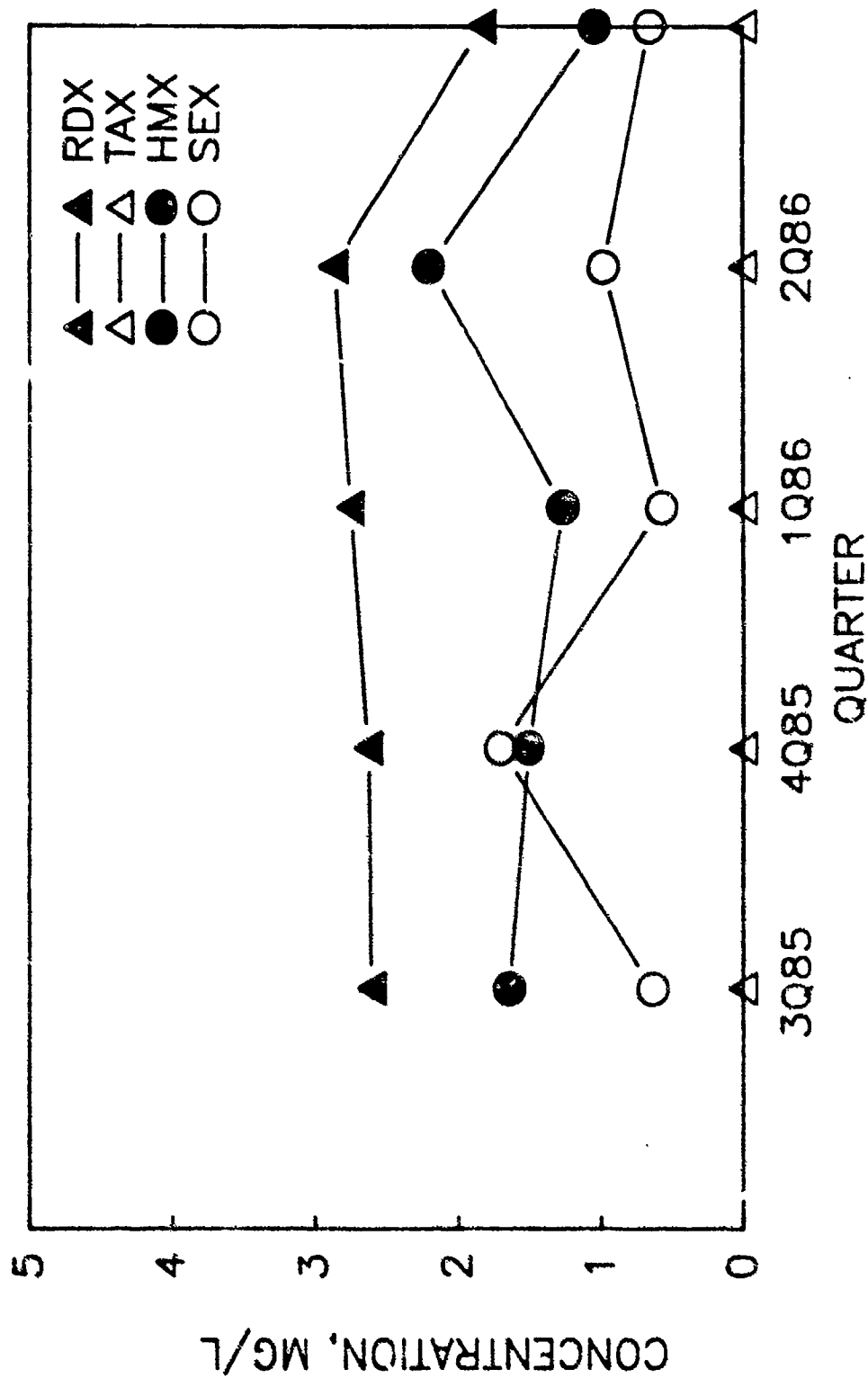


Figure 10. Quarterly Average Nitramines, Final Effluent.

SUMMARY AND RECOMMENDATIONS

1. The HSAAP wastewater treatment plant is a well-constructed facility of conventional design, built to accommodate half the average wastewater flow of 12.7 mgd and maximum flow of 15 mgd projected for full mobilization. Performances of specific units during the period 1 January 1985 to 31 August 1986 are summarized below:

a. The upflow, fixed-film anoxic filters are the least satisfactory part of the system. Designed to provide 95% nitrate removal, they have achieved no more than 50% removal during the observation period. Furthermore, the filters are subject to frequent biomass plugging. The second problem should be correctable through fairly simple design modifications. The first problem may not be correctable, but should be acceptable at HSAAP provided that (1) discharge criteria are not lowered and (2) historic nitrate ponds at HSAAP are discharged to the wastewater treatment plant at a rate slow enough to prevent permit violations.

b. The aerobic (trickling) filter was not operated during the observation period, but limited data are available for 1984. Organic removals of 50% or better were achieved.

c. The activated sludge system has consistently achieved nearly complete removal of biodegradable organics using less than the available aeration capacity. Clarifiers are generally satisfactory. This system is lightly loaded in terms of organics and suspended solids.

d. The dual media filters have substantially exceeded their design rate of solids capture. They are approaching their hydraulic limits, but are well underloaded in terms of applied solids.

e. Sludge handling facilities (prethickener, aerobic digesters, postthickeners and filter presses) have performed satisfactorily, although the digesters appear not to destroy volatile solids as well as expected.

2. A munitions production rate equal to 15% of full mobilization has been accompanied by an average wastewater flow of 5 mgd or nearly 80% of present treatment plant capacity. The wastewater is much weaker than projected in the original design. The production rate could probably be doubled without expanding the treatment plant, provided that the total discharge not exceed 6 mgd.

3. Experience at HSAAP provides limited guidance for construction of a treatment plant at X-Facility, where the wastewater is expected to be several times stronger with respect to soluble parameters. It is recommended that the HSAAP anoxic filters not be duplicated for nitrate removal. The combination of aerobic filter and aeration basins will probably reduce organics in the stronger wastewater to an acceptable level, but it is recommended that a combined aerobic/anoxic alternative, such as a sequencing batch reactor or a continuous oxidation ditch, be given serious consideration.

EPILOGUE

In the latter part of 1986, after USABRDL had completed its studies, the decision was made to bring the aerobic filter back on line, while reducing the number of aeration basins in service. This would result in a net energy saving while still meeting the discharge limits for BOD₅ (Table 2). As of November 1987, only Basin 5 (Figure 5), with a capacity of 0.6 million gallons, was in service. Historic nitrate ponds are no longer discharged to the waste treatment facility; influent and effluent NO₃-N levels are currently about 5 mg/L and 2 mg/L, respectively.

LITERATURE CITED

1. Clark, Dietz and Associates - Engineers, Inc. 1974. Industrial Waste Treatment Facilities. Holston Army Ammunition Plant. Preliminary Engineering Report for Contract DACA01-73-C-0110. Design Calculations.
2. Marsack, P.A. 1986. Relationship of Product Mix to Industrial Wastewater Flow. Holston Defense Corporation Report to Holston Army Ammunition Plant, Kingsport, TN.
3. Hash, R.L., J.R. Evans and P.V. Simerly. 1977. Pilot Plant Investigation for Treatment of Explosive Contaminated Wastewater from Holston Army Ammunition Plant. Final Engineering Report (HDC-32-77), Contract No. DAAA09-73-C-0079.
4. U.S. Army Environmental Hygiene Agency. 1985. Water Quality Engineering Study No. 32-24-8871-85; Army Pollution Abatement Program Compliance Test, Industrial Wastewater Treatment Plant, Holston Army Ammunition Plant, Kingsport, TN, 26 April - 10 May 1984. Aberdeen Proving Ground, MD.
5. American Public Health Association. 1980. Standard Methods for the Examination of Water and Wastewater 16th Ed. Washington, DC.
6. Brueggemann, E.E. 1982. HPLC Analysis of SEX, HMX, TAX, RDX and TNT in Wastewater. Technical Report 8206, AD A127348. U.S. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD.
7. Personal communication from Patricia Marsack, Holston Defense Corporation.
8. U.S. Environmental Protection Agency. 1980. Innovative and Alternative Technology Assessment Manual. EPA-430/9-78-009.
9. Clark, Dietz, and Associates - Engineers, Inc. 1974. Industrial Waste Treatment Facilities, Holston Army Ammunition Plant, Vol. II. Preliminary Engineering Report, Contract DACA01-73-C-0110.
10. Eckenfelder, W.W., Jr. 1980. Principles of Water Quality Management. CBI Publishing Co., Inc., Boston, MA. p326

11. Alexander, H.J. 1986. Study of Industrial Wastewater Denitrification System. Final Report for Holston Defense Corporation Purchase No. 086-0022. Advanced Sciences, Inc., Oak Ridge, TN.
12. Carnahan, R.P. Anaerobic Fixed Film, Plug Flow, Reactors for Dissimilatory Nitrate Reduction of Munition Waste. Report in preparation, Contract DAMD17-83-C-3211.
13. Grady, C.P.L., Jr, and J.E. Etzel. 1974. Development of Design Parameters for Treatment of Industrial Wastewater from Holston Army Ammunition Plant. Project No. 7744-57-1284, Purdue Research Foundation; prepared for Clark, Dietz and Associates, Urbana IL.
14. Metcalf & Eddy, Inc. 1972. Wastewater Engineering: Collection, Treatment, Disposal. McGraw-Hill Book Co., New York, NY, p433.
15. Adams, C.E., Jr, and W.W. Eckenfelder, Jr, editors. 1974. Process Design Techniques for Industrial Waste Treatment. Enviro Press, Inc., Nashville, TN, p53ff.
16. U.S. Army Armament Research and Development Command. 1979. As quoted in Kitchens, J.F. et al. 1980. Pilot Scale Evaluation of the Treatability of RDX/HMX Site "X" Facility Wastewaters. Final Report, Contract ARCSL-CR-80028, ARRADCOM, Aberdeen Proving Ground, MD.
17. Bell, B.A., W.D. Burrows and J.A. Carrazza. 1987. Pilot Scale Testing of a Semicontinuous Activated Sludge Treatment System for RDX/HMX Wastewater. AD-E401 740. U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
18. McCormick, N.G., J.H. Cornell and A.M. Kaplan. 1984. The Anaerobic Biotransformation of RDX, HMX, and Their Acetylated Derivatives. TR-85/007. U.S. Army Natick Research and Development Center, Natick, MA.
19. Burrows, W.D. and M.O. Schmidt. 1986. Biological Treatment of Composition B Wastewaters I. Rotating Biological Contactor. TR 8606, AD A180738. U.S. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD.

APPENDIX A

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Area A and Area B

(Single Consolidated Outfall)

Effluent Characteristic	Discharge Limitations		Other Units		Monitoring Requirements		Sample Type
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency		
Flow-m ³ /day (mgd)					Continuous		
BOD ₅ (May 1 - Oct 31)	367(810)	735(1,620)			Daily	24-hr	Composite
BOD ₅ (Nov 1 - Apr 30)	521(1,215)	1,160(2,430)			Daily	24-hr	Composite
T.S.S.	222(500)	454(1,000)			Daily	24-hr	Composite
T.D.S.	272,000(600,000)	272,000(600,000)			Quarterly		Grab
Total Nitrogen (May 1 - Oct 31)	175(385)	354(780)			Daily	24-hr	Composite
Total Nitrogen (Nov 1 - Apr 30)	272(600)	354(780)			Daily	24-hr	Composite
Ammonia (as N) (May 1 - Oct 31)	45(100)	91(200)			Daily	24-hr	Composite
Ammonia (as N) (Nov 1 - Apr 30)	91(200)	136(300)			Daily	24-hr	Composite
Phosphorus, Total	97(2.3)	97(2.3)			Daily	24-hr	Composite
Phenols	4.5(10)	9(20)			Daily	24-hr	Composite
Chromium, total		0.05 mg/L	0.05 mg/L	0.05 mg/L	Quarterly		Grab
Copper, total		0.05 mg/L	0.05 mg/L	0.10 mg/L	Quarterly		Grab
Lead, total		0.05 mg/L	0.05 mg/L	0.05 mg/L	Quarterly		Grab
Mercury, total		0.005 mg/L	0.005 mg/L	0.005 mg/L	Quarterly		Grab
Settleable solids		0.05 mg/L	0.05 mg/L	0.05 mg/L	Quarterly		Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored by weekly grab sample.

APPENDIX B

DAILY AVERAGE CHEMICAL OXYGEN DEMAND, UPPER NEUTRALIZATION BASIN, MG/L

JAN 85		FEB 85		MAR 85		APR 85	
Date	COD	Date	COD	Date	COD	Date	COD
01	195	01	141	01	274	01	277
02	151	02	203	02	361	02	312
03	229	03	251	03	337	03	299
04	251	04	211	04	295	04	276
05	260	05	196	05	344	05	330
06	332	06	229	06	279	06	414
07	238	07	269	07	382	07	342
08	267	08	319	08	431	08	285
09	315	09	266	09	319	09	325
10	275	10	271	10	347	10	304
11	273	11	330	11	295	11	340
12	218	12	269	12	214	12	261
13	198	13	329	13	374	13	257
14	328	14	250	14	389	14	179
15	244	15	319	15	409	15	217
16	270	16	243	16	274	16	254
17	258	17	286	17	255	17	211
18	294	18	285	18	223	18	204
19	310	19	316	19	206	19	259
20	351	20	276	20	264	20	234
21	216	21	274	21	190	21	300
22	317	22	242	22	222	22	186
23	344	23	283	23	208	23	160
24	231	24	330	24	181	24	169
25	206	25	283	25	314	25	315
26	195	26	272	26	286	26	196
27	163	27	283	27	374	27	280
28	167	28	298	28	321	28	213
29	129			29	241	29	217
30	164	AVG	269	30	200	30	193
31	195			31	184		
AVG	245			AVG	290	AVG	260

DAILY AVERAGE CHEMICAL OXYGEN DEMAND, UPPER NEUTRALIZATION BASIN, MG/L^a

MAY 85		JUN 85		JUL 85		AUG 85	
Date	COD	Date	COD	Date	COD	Date	COD
01	236	01	238	01	341	01	241
02	282	02	274	02	320	02	342
03	212	03	198	03	278	03	203
04	198	04	191	04	282	04	222
05	250	05	262	05	290	05	252
06	208	06	325	06	377	06	212
07	252	07		07	274	07	243
08	220	08		08	285	08	350
09	201	09	216	09	305	09	261
10	229	10	262	10	290	10	264
11	189	11	151	11	311	11	245
12	264	12	197	12	318	12	293
13	282	13	216	13	262	13	294
14	236	14	205	14	247	14	269
15	206	15	258	15	335	15	292
16	287	16	187	16	314	16	232
17	192	17	296	17	285	17	183
18	202	18	298	18	282	18	215
19	189	19	270	19	338	19	233
20	182	20	265	20	388	20	267
21	182	21	280	21	301	21	317
22	197	22	261	22	322	22	224
23	223	23	342	23	275	23	198
24	214	24	226	24	241	24	232
25	262	25	121	25	325	25	274
26	218	26	224	26	294	26	221
27	241	27	300	27	262	27	298
28	219	28	325	28	230	28	227
29	219	29	251	29	297	29	352
30	243	30	287	30	188	30	284
31	363			31	225	31	286
AVG	229	AVG	247	AVG	293	AVG	259

a. Blank spaces indicate data not collected.

DAILY AVERAGE CHEMICAL OXYGEN DEMAND, UPPER NEUTRALIZATION BASIN, MG/L

SEP 85		OCT 85		NOV 85		DEC 85	
Date	COD	Date	COD	Date	COD	Date	COD
01	201	01	266	01	257	01	291
02	237	02	380	02	276	02	294
03	321	03	318	03	260	03	291
04	289	04	285	04	283	04	263
05	324	05	277	05	271	05	267
06	324	06	278	06	371	06	277
07	268	07	259	07	256	07	257
08	289	08	269	08	259	08	293
09	265	09	221	09	316	09	252
10	229	10	267	10	285	10	289
11	237	11	252	11	280	11	244
12	247	12	317	12	280	12	305
13	256	13	295	13	288	13	380
14	285	14	287	14	294	14	302
15	321	15	306	15	295	15	362
16	311	16	258	16	297	16	453
17	335	17	259	17	314	17	313
18	322	18	281	18	450	18	333
19	367	19	333	19	383	19	403
20	330	20	326	20	348	20	318
21	223	21	244	21	363	21	292
22	309	22	239	22	283	22	262
23	300	23	261	23	271	23	310
24	290	24	260	24	321	24	461
25	264	25	255	25	338	25	400
26	238	26	235	26	268	26	285
27	231	27	269	27	313	27	320
28	255	28	279	28	328	28	265
29	226	29	321	29	235	29	202
30	220	30	268	30	186	30	275
		31	265			31	292
AVG	277	AVG	278	AVG	299	AVG	308

DAILY AVERAGE CHEMICAL OXYGEN DEMAND, UPPER NEUTRALIZATION BASIN, MG/L

JAN 86		FEB 86		MAR 86		APR 86	
Date	COD	Date	COD	Date	COD	Date	COD
01	347	01	369	01	327	01	248
02	251	02	299	02	355	02	213
03	415	03	345	03	315	03	292
04	300	04	301	04	279	04	507
05	454	05	245	05	289	05	304
06	296	06	360	06	327	06	235
07	478	07	303	07	342	07	246
08	300	08	425	08	297	08	220
09	305	09	302	09	314	09	210
10	278	10	232	10	282	10	347
11	316	11	289	11	284	11	202
12	277	12	259	12	242	12	301
13	322	13	246	13	301	13	231
14	319	14	321	14	278	14	153
15	315	15	270	15	414	15	163
16	358	16	283	16	312	16	208
17	386	17	263	17	290	17	206
18	390	18	262	18	255	18	178
19	291	19	275	19	282	19	208
20	306	20	392	20	273	20	159
21	240	21	286	21	259	21	139
22	372	22	263	22	292	22	225
23	417	23	310	23	282	23	175
24	361	24	328	24	279	24	254
25	393	25	331	25	329	25	153
26	323	26	335	26	269	26	136
27	334	27	310	27	268	27	106
28	308	28	354	28	292	28	104
29	285			29	268	29	105
30	354	AVG	306	30	336	30	137
31	340			31	260		
AVG	336			AVG	297	AVG	212

DAILY AVERAGE CHEMICAL OXYGEN DEMAND, UPPER NEUTRALIZATION BASIN, MG/L

MAY 86		JUN 86		JUL 86		AUG 86	
Date	COD	Date	COD	Date	COD	Date	COD
01	104	01	105	01	148	01	255
02	153	02	215	02	137	02	256
03	233	03	172	03	201	03	280
04	220	04	176	04	157	04	156
05	208	05	172	05	423	05	151
06	302	06	110	06	248	06	179
07	262	07	163	07	344	07	158
08	232	08	94	08	151	08	119
09	192	09	167	09	287	09	137
10	220	10	107	10	117	10	140
11	192	11	111	11	131	11	147
12	178	12	103	12	139	12	181
13	189	13	127	13	80	13	169
14	162	14	91	14	165	14	167
15	201	15	217	15	171	15	181
16	159	16	161	16	227	16	194
17	153	17	245	17	166	17	152
18	234	18	183	18	163	18	144
19	159	19	207	19	202	19	147
20	142	20	244	20	200	20	174
21	164	21	166	21	202	21	154
22	115	22	178	22	123	22	174
23	287	23	126	23	193	23	197
24	269	24	143	24	212	24	106
25	211	25	131	25	141	25	163
26	206	26	98	26	175	26	203
27	173	27	175	27	149	27	170
28	178	28	153	28	176	28	292
29	185	29	143	29	145	29	124
30	155	30	100	30	187	30	110
31	096			31	231	31	194
AVG	191	AVG	153	AVG	187	AVG	173

APPENDIX C

DAILY AVERAGE NITRATE NITROGEN, AREA B WASTEWATER, MG/L

JAN 85		FEB 85		MAR 85		APR 85	
Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N
01	13	01	29	01	19	01	24
02	15	02	25	02	17	02	40
03	16	03	22	03	25	03	41
04	15	04	21	04	27	04	40
05	13	05	27	05	29	05	26
06	18	06	28	06	30	06	32
07	14	07	23	07	35	07	48
08	12	08	18	08	32	08	40
09	20	09	18	09	26	09	36
10	20	10	17	10	26	10	34
11	21	11	14	11	30	11	31
12	15	12	14	12	40	12	25
13	16	13	11	13	45	13	46
14	15	14	13	14	43	14	20
15	22	15	14	15	50	15	35
16	15	16	12	16	40	16	32
17	29	17	13	17	42	17	16
18	18	18	10	18	49	18	32
19	28	19	9	19	47	19	33
20	22	20	11	20	47	20	32
21	24	21	10	21	20	21	18
22	14	22	11	22	30	22	17
23	22	23	11	23	42	23	37
24	23	24	14	24	39	24	60
25	12	25	12	25	39	25	7
26	14	26	13	26	29	26	49
27	15	27	14	27	29	27	45
28	15	28	18	28	30	28	27
29	15			29	29	29	53
30	15	AVG	16	30	17	30	30
31	14			31	31		
AVG	17			AVG	33	AVG	34

DAILY AVERAGE NITRATE NITROGEN, AREA B WASTEWATER, MG/L

MAY 85		JUN 85		JUL 85		AUG 85	
Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N
01	21	01	31	01	18	01	10
02	29	02	34	02	27	02	15
03	55	03	30	03	26	03	18
04	35	04	29	04	27	04	14
05	33	05	45	05	12	05	32
06	41	06	39	06	10	06	37
07	45	07	12	07	12	07	26
08	54	08	1	08	21	08	26
09	53	09	6	09	23	09	29
10	62	10	12	10	41	10	36
11	36	11	10	11	37	11	40
12	43	12	11	12	45	12	44
13	43	13	10	13	40	13	41
14	28	14	14	14	42	14	43
15	38	15	4	15	18	15	35
16	47	16	4	16	35	16	22
17	46	17	15	17	42	17	20
18	23	18	28	18	41	18	33
19	08	19	34	19	28	19	31
20	33	20	7	20	15	20	32
21	34	21	7	21	23	21	27
22	42	22	9	22	23	22	34
23	49	23	9	23	19	23	27
24	25	24	22	24	24	24	37
25	37	25	21	25	21	25	32
26	47	26	14	26	39	26	29
27	45	27	14	27	19	27	25
28	51	28	17	28	39	28	39
29	51	29	16	29	31	29	36
30	25	30	33	30	23	30	31
31	22			31	32	31	43
AVG	39	AVG	18	AVG	28	AVG	30

DAILY AVERAGE NITRATE NITROGEN, AREA B WASTEWATER, MG/L^a

SEPT 85		OCT 85		NOV 85		DEC 85	
Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N
01	42	01	51	01	63	01	37
02	17	02	48	02	31	02	30
03	35	03	42	03	44	03	51
04	34	04	28	04	37	04	33
05	42	05	45	05	55	05	47
06	37	06	39	06	51	06	47
07	41	07	42	07	64	07	22
08	42	08	37	08		08	6
09	41	09	44	09	18	09	9
10	20	10	47	10	38	10	51
11	54	11	43	11	51	11	46
12	28	12	53	12	67	12	42
13	51	13	54	13	63	13	43
14	44	14		14	57	14	43
15	46	15		15	58	15	44
16	18	16		16	50	16	33
17	38	17		17	45	17	9
18	42	18		18	35	18	6
19	50	19		19	6	19	6
20	45	20		20		20	6
21	36	21	29	21	20	21	5
22	40	22	47	22	35	22	6
23	32	23		23	47	23	5
24	37	24	34	24	49	24	6
25	41	25	43	25	49	25	7
26	50	26	45	26	44	26	10
27	56	27	34	27	43	27	16
28	51	28	46	28	41	28	8
29	67	29	27	29	36	29	6
30	48	30	35	30	29	30	6
		31	44			31	8
AVG	40			AVG	42		
		AVG	41			AVG	22

a. Blank spaces indicate data not collected.

DAILY AVERAGE NITRATE NITROGEN, AREA B WASTEWATER, MG/L

JAN 86		FEB 86		MAR 86		APR 86	
Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N
01	9	01	9	01	6	01	44
02	8	02	12	02	5	02	24
03	7	03	11	03	5	03	19
04	7	04	9	04	6	04	24
05	8	05	11	05	7	05	18
06	6	06	10	06	6	06	13
07	7	07	7	07	6	07	12
08	7	08	10	08	6	08	10
09	8	09	10	09	5	09	8
10	9	10	8	10	10	10	9
11	10	11	15	11	10	11	8
12	8	12	14	12	7	12	7
13	8	13	14	13	8	13	6
14	7	14	13	14	7	14	6
15	9	15	11	15	6	15	6
16	23	16	11	16	7	16	8
17	36	17	11	17	9	17	15
18	8	18	6	18	9	18	24
19	12	19	9	19	8	19	29
20	12	20	14	20	7	20	25
21	13	21	10	21	8	21	22
22	15	22	11	22	10	22	32
23	16	23	10	23	8	23	33
24	11	24	9	24	8	24	36
25	13	25	10	25	9	25	41
26	7	26	14	26	8	26	19
27	7	27	7	27	5	27	31
28	7	28	6	28	6	28	14
29	10			29	5	29	27
30	10	AVG	10	30	4	30	31
31	8			31	14		
AVG	11			AVG	7	AVG	20

DAILY AVERAGE NITRATE NITROGEN, AREA B WASTEWATER, MG/L^a

MAY 86		JUN 86		JUL 86		AUG 86	
Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N	Date	NO ₃ -N
01	16	01	21	01	25	01	25
02	31	02	21	02	27	02	8
03	8	03	22	03	26	03	2
04	11	04	22	04	24	04	4
05	22	05	27	05	22	05	26
06	43	06	29	06	24	06	14
07	39	07	11	07	29	07	27
08	38	08	28	08	19	08	24
09	37	09	15	09	19	09	24
10	28	10	28	10	22	10	33
11	36	11	24	11	28	11	27
12	37	12	24	12	37	12	20
13	43	13	9	13	26	13	35
14	45	14	20	14	28	14	35
15	49	15	21	15	30	15	36
16	39	16	16	16	22	16	27
17	47	17	19	17	25	17	30
18	44	18	23	18	29	18	25
19	29	19	25	19	28	19	27
20	42	20	21	20	37	20	
21	23	21	14	21	29	21	
22	10	22	14	22	25	22	
23		23	21	23	47	23	
24		24	33	24	39	24	
25		25	25	25	32	25	18
26		26	24	26	38	26	17
27		27	22	27	35	27	15
28		28	9	28	35	28	24
29		29	22	29	26	29	31
30	21	30	20	30	32	30	26
31	22			31	35	31	29
AVG	32	AVG	21	AVG	29	AVG	23

a. Blank spaces indicate data not collected.

APPENDIX D

DAILY AVERAGE TEMPERATURE (°C) AND pH, UPPER NEUTRALIZATION BASIN^a

JAN 85			FEB 85			MAR 85			APR 85		
Date	Temp	pH	Date	Temp	pH	Date	Temp	pH	Date	Temp	pH
01	22.1	7.1	01	15.7	6.5	01	20.4	6.7	01	23.1	7.1
02	21.0	7.0	02			02	20.6	6.5	02	21.8	7.2
03	20.2	6.0	03	14.8	6.7	03	20.3	6.7	03	21.6	7.1
04	20.4	6.5	04	19.6	6.7	04	21.6	6.8	04	23.1	7.2
05	17.8	7.1	05	16.4	6.5	05	21.3	6.5	05	23.9	6.9
06	19.7	7.1	06	15.6	6.8	06	19.9	6.9	06	22.8	7.0
07	18.9	7.1	07	17.7	6.3	07	20.9	6.9	07	22.9	7.0
08	19.7	7.3	08	15.1	6.7	08	22.5	7.0	08	21.9	6.9
09	17.7	6.7	09	16.1	6.5	09	21.1	7.0	09	20.9	7.3
10	18.0	6.9	10	17.5	6.4	10	21.5	6.9	10	20.9	7.6
11	19.0	7.0	11	20.2	6.3	11	21.6	6.8	11	21.5	7.1
12	17.7	7.3	12	16.0	6.4	12	23.1	7.2	12	22.9	7.3
13	17.8	7.2	13	16.8	5.7	13	21.8	6.8	13	23.3	7.0
14	17.6	7.0	14	14.5	6.9	14	21.9	6.9	14	24.7	6.7
15	17.8	7.0	15	16.3	6.9	15	21.7	6.9	15	24.3	7.0
16	17.2	7.2	16	14.9	6.3	16	23.0	6.6	16	23.6	7.1
17	16.7	6.6	17	18.1	6.5	17	22.3	7.0	17	24.6	7.0
18	17.7	7.0	18	19.1	7.6	18	21.0	7.0	18	25.2	7.2
19	16.7	6.8	19	20.5	6.8	19	21.6	6.9	19	26.6	7.3
20	13.1	6.7	20	18.9	6.5	20	22.4	7.1	20	26.9	7.1
21	12.6	6.1	21	18.1	7.2	21	21.2	6.9	21	26.8	7.2
22	13.7	6.3	22	19.2	6.8	22	20.3	7.3	22	25.5	7.5
23	16.7	6.7	23	21.0	6.4	23	21.2	7.4	23	24.9	6.9
24	15.2	6.4	24			24	21.2	7.2	24	26.2	7.0
25	17.7	7.1	25	20.6	6.3	25	22.0	7.2	25	26.2	7.0
26	13.3	7.1	26	21.1	6.9	26	21.7	7.2	26	26.5	7.1
27	15.2	7.3	27	20.9	6.5	27	22.0	6.8	27	25.6	7.2
28	14.7	6.7	28	20.5	6.7	28	22.7	6.8	28	25.9	7.0
29	19.2	7.4				29	21.6	7.1	29	25.5	7.0
30	15.7	7.1				30	24.3	7.1	30	28.0	6.9
31	18.3	6.6				31	24.2	7.2			

a. Blank spaces indicate data not collected.

DAILY AVERAGE TEMPERATURE (°C) AND pH, UPPER NEUTRALIZATION BASIN^a

MAY 85			JUN 85			JUL 85			AUG 85		
Date	Temp	pH	Date	Temp	pH	Date	Temp	pH	Date	Temp	pH
01	25.0	6.8	01	15.7	6.5	01	20.4	6.7	01	23.1	7.1
02	26.0	7.0	02			02	20.6	6.5	02	21.8	7.2
03	23.7	7.0	03	14.8	6.7	03	20.3	6.7	03	21.6	7.1
04	23.4	7.0	04	19.6	6.7	04	21.6	6.8	04	23.1	7.2
05	24.7	6.9	05	16.4	6.5	05	21.3	6.5	05	23.9	6.9
06	24.3	6.9	06	15.6	6.8	06	19.9	6.9	06	22.8	7.0
07	24.3	7.2	07	17.7	6.3	07	20.9	6.9	07	22.9	7.0
08	24.2	8.0	08	15.1	6.7	08	22.5	7.0	08	21.9	6.9
09	24.2	7.4	09	16.1	6.5	09	21.1	7.0	09	20.9	7.3
10	23.9	7.4	10	17.5	6.4	10	21.5	6.9	10	20.9	7.6
11	24.5	7.2	11	20.2	6.3	11	21.6	6.8	11	21.5	7.1
12	24.9	6.9	12	16.0	6.4	12	23.1	7.2	12	22.9	7.3
13	25.5	6.8	13	16.8	5.7	13	21.8	6.8	13	23.3	7.0
14	24.9	6.7	14	14.5	6.9	14	21.9	6.9	14	24.7	6.7
15	24.9	7.1	15	16.3	6.9	15	21.7	6.9	15	24.3	7.0
16	24.0	7.4	16	14.9	6.3	16	23.0	6.6	16	23.6	7.1
17	23.6	7.1	17	18.1	6.5	17	22.3	7.0	17	24.6	7.0
18	24.3	7.2	18	19.1	7.6	18	21.0	7.0	18	25.2	7.2
19	23.5	6.9	19	20.5	6.8	19	21.6	6.9	19	25.6	7.3
20	25.5	6.9	20	18.9	6.5	20	22.4	7.1	20	26.9	7.1
21	24.9	7.1	21	18.1	7.2	21	21.2	6.9	21	26.8	7.2
22	25.9	6.9	22	19.2	6.8	22	20.3	7.3	22	25.5	7.5
23	25.3	7.0	23	21.0	6.4	23	21.2	7.4	23	24.9	6.9
24	25.4	7.1	24			24	21.2	7.2	24	26.2	7.0
25	24.2	6.7	25	20.6	6.3	25	22.0	7.2	25	26.2	7.0
26	24.1	7.2	26	21.1	6.9	26	21.7	7.2	26	26.5	7.1
27	25.4	6.8	27	20.9	6.5	27	22.0	6.8	27	25.6	7.2
28	24.6	7.3	28	20.5	6.7	28	22.7	6.8	28	25.9	7.0
29	25.8	7.2				29	21.6	7.1	29	25.5	7.0
30	25.3	7.4				30	24.3	7.1	30	28.0	6.9
31	27.4	7.3				31	24.2	7.2			

a. Blank spaces indicate data not collected.

DAILY AVERAGE TEMPERATURE (°C) AND pH, UPPER NEUTRALIZATION BASIN

SEPT 85			OCT 85			NOV 85			DEC 85		
Date	Temp	pH	Date	Temp	pH	Date	Temp	pH	Date	Temp	pH
01	26.1	7.1	01	23.4	7.0	01	25.2	7.2	01	20.5	7.3
02	25.3	8.2	02	24.1	7.1	02	23.7	7.1	02	19.6	7.2
03	25.6	7.0	03	24.5	6.9	03	23.5	7.4	03	18.4	7.4
04	25.3	6.6	04	24.9	6.7	04	20.2	7.1	04	18.1	7.1
05	25.1	7.0	05	22.7	7.0	05	19.0	8.1	05	18.3	7.1
06	23.8	7.1	06	20.0	7.0	06	20.3	7.0	06	18.8	7.1
07	25.4	7.1	07	21.5	7.3	07	19.3	7.2	07	19.9	7.1
08	25.7	7.1	08	22.5	7.2	08	18.9	7.3	08	20.0	7.0
09	24.4	6.9	09	23.1	7.3	09	18.2	7.1	09	20.6	7.1
10	25.4	7.0	10	23.9	7.6	10	20.1	7.1	10	20.7	7.2
11	24.4	7.0	11	24.8	7.6	11	22.5	7.3	11	19.3	7.4
12	24.4	7.0	12	23.6	7.4	12	22.8	7.3	12	20.7	7.3
13	24.4	7.1	13	24.0	7.2	13	21.3	7.3	13	19.3	7.1
14	24.0	7.2	14	24.3	7.3	14	22.3	6.9	14	18.2	6.9
15	22.9	7.0	15	22.1	7.0	15	21.7	7.0	15	15.3	7.1
16	23.7	6.7	16	23.6	7.1	16	22.6	7.1	16	18.1	6.6
17	24.7	6.9	17	24.3	7.3	17	22.6	7.1	17	16.4	6.7
18	24.5	7.2	18	24.2	7.1	18	21.5	6.6	18	17.1	6.7
19	22.5	7.0	19	25.6	7.2	19	23.1	6.6	19	14.9	6.5
20	24.2	7.1	20	25.1	6.8	20	23.2	6.4	20	14.3	6.9
21	23.7	7.1	21	24.5	7.5	21	21.5	6.1	21	13.0	7.1
22	23.4	7.3	22	23.7	6.8	22	20.3	7.1	22	14.0	6.9
23	24.0	7.3	23	24.7	6.7	23	20.0	6.9	23	15.1	7.4
24	24.3	7.2	24	23.9	7.0	24	20.9	7.0	24	15.2	6.2
25	24.4	7.3	25	24.5	6.5	25	21.4	6.5	25	10.5	6.9
26	23.4	7.2	26	23.6	6.8	26	22.0	6.9	26	13.1	6.8
27	22.2	7.3	27	23.1	7.2	27	22.4	7.2	27	13.8	6.9
28	23.6	7.1	28	22.3	6.7	28	21.1	7.2	28	12.1	6.9
29	24.4	7.2	29	21.2	6.7	29	21.7	7.1	29	14.3	7.1
30	24.9	7.1	30	22.8	7.0	30	20.0	7.2	30	14.4	7.0
			31	23.1	6.9				31	12.7	6.8

DAILY AVERAGE TEMPERATURE (°C) AND pH, UPPER NEUTRALIZATION BASIN

JAN 86			FEB 86			MAR 86			APRIL 86		
Date	Temp	pH	Date	Temp	pH	Date	Temp	pH	Date	Temp	pH
01	13.5	7.0	01	16.0	7.0	01	14.6	7.0	01	21.8	8.3
02	13.9	6.9	02	16.2	6.5	02	14.5	6.7	02	22.3	7.3
03	14.7	6.9	03	16.1	6.4	03	15.3	6.8	03	22.7	7.2
04	17.5	7.0	04	17.3	6.8	04	15.2	6.5	04	22.6	7.3
05	14.7	6.9	05	17.0	6.5	05	14.9	6.7	05	22.6	7.2
06	12.2	6.9	06	16.4	6.5	06	14.5	6.7	06	22.1	7.2
07	12.7	6.9	07	17.2	6.4	07	14.4	6.7	07	21.3	7.2
08	11.8	6.8	08	17.5	6.5	08	14.6	7.1	08	21.7	7.2
09	12.7	7.6	09	17.1	6.5	09	17.1	7.1	09	19.4	7.1
10	11.5	6.6	10	15.5	6.6	10	19.2	7.0	10	19.7	7.1
11	14.0	6.7	11	15.6	6.9	11	19.2	7.0	11	21.5	7.2
12	14.9	6.8	12	13.8	6.8	12	19.4	7.1	12	19.6	7.1
13	13.4	6.7	13	13.6	6.6	13	19.4	7.0	13	22.3	7.1
14	13.7	6.9	14	11.9	6.5	14	18.9	7.0	14	23.0	7.3
15	14.9	6.7	15	12.7	6.5	15	17.6	6.2	15	22.6	7.0
16	15.0	6.6	16	13.0	6.3	16	18.9	6.6	16	19.9	6.7
17	15.2	6.6	17	14.2	5.8	17	19.3	6.8	17	20.6	6.9
18	15.7	6.2	18	15.8	6.6	18	20.0	6.8	18	20.9	7.0
19	15.9	6.9	19	17.1	5.7	19	20.2	7.1	19	23.4	7.2
20	14.6	6.6	20	18.1	6.1	20	16.0	7.0	20	23.1	7.0
21	15.0	6.8	21	16.2	6.3	21	14.0	6.8	21	22.7	7.2
22	16.6	7.0	22	14.8	6.4	22	16.3	7.1	22	20.8	7.3
23	16.4	6.5	23	15.9	6.6	23	17.3	7.0	23	19.9	7.3
24	15.4	6.5	24	15.2	6.6	24	18.8	6.9	24	21.4	8.3
25	15.1	6.7	25	15.4	6.6	25	19.6	7.2	25	23.4	8.2
26	14.1	6.8	26	14.6	6.6	26	18.7	7.0	26	23.7	7.1
27	11.6	6.8	27	16.4	7.7	27	20.0	7.1	27	24.1	7.0
28	9.5	6.9	28	14.6	7.4	28	19.8	6.9	28	23.8	6.7
29	11.3	6.8				29	19.8	6.8	29	22.9	7.0
30	12.3	6.9				30	21.2	6.8	30	22.6	7.1
31	13.1	6.9				31	21.8	7.0			

APPENDIX E

Anoxic Filter Effluent: Daily Average Parameters (mg/L)
(Blank spaces indicate data not collected.)

DATE ----	COD ---	NO3N ----	DATE ----	COD ---	NO3N ----
10/22/84	131.7	2.97	12/10/84	199.0	10.97
18/23/84	127	1.21	12/11/84	150.0	13.77
10/24/84	147.0	1.11	12/12/84	188.0	18.00
10/25/84	91.7	1.64	12/13/84	213.3	14.60
10/26/84	111.0	0.92	12/14/84	215.0	16.73
10/27/84	99.7	1.75	12/15/84	108.7	12.57
10/28/84	150.3	2.24	12/16/84	114.7	9.67
10/29/84	115.3	2.49	12/17/84	169.7	42.00
10/30/84	48.3	4.70	12/18/84	109.7	10.33
10/31/84	56.7	5.37	12/19/84	110.3	9.33
11/01/84	78.7	3.31	12/20/84	82.7	11.21
11/02/84	95.3	1.77	12/21/84	95.0	17.63
11/03/84	104.7	1.90	12/22/84	117.0	35.27
11/04/84	188.0	10.07	12/23/84	183.3	43.40
11/05/84	183.0	1.97	12/24/84	165.3	87.37
11/06/84	209.5	5.30	12/25/84	150.0	103.93
11/06/84	201	4.3	12/26/84	144.3	11.00
11/07/84	165.3	2.97	12/27/84	140.7	19.67
11/08/84	177.7	1.84	12/28/84	195.7	17.60
11/09/84	157.0	2.33	12/29/84	146.7	16.67
11/10/84	159.7	8.33	12/30/84	146.3	54.73
11/11/84	135.7	1.47	12/31/84	143.3	22.27
11/12/84	203.7	102.27	01/01/85	132.0	6.23
11/13/84	172.7	15.50	01/02/85	133.0	3.33
11/14/84	177.3	21.13	01/03/85	353.3	2.00
11/15/84	191.7	39.60	01/04/85	143.0	12.33
11/16/84	243.3	49.47	01/05/85	170.0	7.23
11/17/84	256.7	26.03	01/06/85	205.3	11.00
11/18/84	233.0	27.47	01/07/85	227.0	5.53
11/19/84	91.0	7.67	01/08/85	189.3	7.77
11/20/84	124.0	34.26	01/09/85	226.3	10.53
11/21/84	151.0	5.57	01/10/85	259.0	9.23
11/22/84	163.3	4.47	01/11/85	237.3	14.87
11/23/84	130.7	9.53	01/12/85	206.7	5.33
11/24/84	132.3	9.67	01/13/85	175.7	19.00
11/25/84	191.3	9.87	01/14/85	285.3	22.33
11/26/84	142.0	9.16	01/15/85	204.7	16.33
11/27/84	138.3	4.43	01/16/85	197.0	16.00
11/28/84	155.7	5.00	01/17/85	222.3	27.97
11/29/84	151.3		01/18/85	274.0	15.33
11/30/84	200.3		01/19/85	294.0	42.70
12/01/84	228.3		01/20/85	261.3	21.80
12/02/84	210.0		01/21/85	193.0	22.20
12/03/84	172.7	55.35	01/22/85	203.0	8.17
12/04/84	191.7	7.37	01/23/85	271.3	9.47
12/05/84	186.3	6.53	01/24/85	191.7	18.10
12/06/84	177.0	3.77	01/25/85	191.0	12.70
12/07/84	233.3	11.37	01/26/85	162.7	12.40
12/08/84	193.0	16.20	01/27/85	154.7	12.93
12/09/84	160.0	13.50	01/28/85	259.0	9.63

DATE ----	COD ---	NO3N ----
01/29/85	153.3	7.40
01/30/85	149.3	9.17
01/31/85	178.3	8.60
02/01/85	116.3	9.67
02/02/85	181.3	7.80
02/03/85	193.3	15.20
02/04/85	187.0	12.53
02/05/85	203.0	15.13
02/06/85	219.0	15.53
02/07/85	251.7	12.40
02/08/85	337.0	11.33
02/09/85	248.7	11.83
02/10/85	260.3	13.60
02/11/85	266.3	30.67
02/12/85	259.3	59.00
02/13/85	270.0	6.40
02/14/85	259.0	6.33
02/15/85	297.0	6.53
02/16/85	201.3	3.27
02/17/85	206.0	4.20
02/18/85	286.0	3.93
02/19/85	231.7	4.47
02/20/85	258.0	6.27
02/21/85	281.3	5.80
02/22/85	255.3	8.40
02/23/85	288.3	7.63
02/24/85	318.3	10.43
02/25/85	263.0	7.60
02/26/85	281.7	10.50
02/27/85	263.3	8.70
02/28/85	291.0	12.27
03/01/85	266.0	14.67
03/02/85	295.3	12.53
03/03/85	306.0	14.73
03/04/85	253.0	14.93
03/05/85	255.7	16.80
03/06/85	258.7	15.10
03/07/85	329.3	14.90
03/08/85	310.7	16.03
03/09/85	243.0	14.67
03/10/85	253.0	18.67
03/11/85	226.7	10.67
03/12/85	220.3	11.67
03/13/85	193.7	19.00
03/14/85	289.0	13.33
03/15/85	315.7	15.33
03/16/85	220.7	17.00
03/17/85	191.0	13.33
03/18/85	168.0	18.33
03/19/85	155.0	15.00

DATE ----	COD ---	NO3N ----
03/20/85	236.7	21.25
03/21/85	153.7	17.00
03/22/85	210.7	12.67
03/23/85	215.3	14.00
03/24/85	128.7	11.00
03/25/85	182.3	13.33
03/26/85	199.0	11.00
03/27/85	196.3	9.67
03/28/85	174.7	11.00
03/29/85	199.0	13.33
03/30/85	180.3	8.00
03/31/85	134.0	6.67
04/01/85	184.3	4.00
04/02/85	216.7	8.00
04/03/85	249.0	12.67
04/04/85	222.3	9.33
04/05/85	271.3	10.00
04/06/85	321.7	7.67
04/07/85	193.0	8.33
04/08/85	228.3	9.67
04/09/85	214.0	8.00
04/10/85	254.0	8.53
04/11/85	217.3	10.83
04/12/85	215.0	3.50
04/13/85	279.7	7.80
04/14/85	157.7	3.80
04/15/85	214.0	7.43
04/16/85	184.7	9.03
04/17/85	186.0	6.67
04/18/85	168.7	6.07
04/19/85	217.7	8.27
04/20/85	186.7	3.57
04/21/85	174.7	3.20
04/22/85	165.7	8.73
04/23/85	157.7	20.00
04/24/85	133.0	33.40
04/25/85	214.7	11.00
04/26/85	188.3	17.75
04/27/85	166.0	15.12
04/28/85	200.3	4.20
04/29/85	145.3	22.80
04/30/85	173.3	18.67
05/01/85	223.3	26.00
05/02/85	221.0	20.10
05/03/85	206.7	33.87
05/04/85	161.3	23.00
05/05/85	168.7	19.33
05/06/85	155.0	23.33
05/07/85	194.0	27.67
05/08/85	185.3	31.40

DATE COD NO3N

05/09/85	172.3	25.63
05/10/85	147.3	22.15
05/11/85	154.0	18.00
05/12/85	195.7	21.30
05/13/85	197.3	26.65
05/14/85	180.0	8.57
05/15/85	156.7	17.33
05/16/85	183.0	21.93
05/17/85	176.3	25.17
05/18/85	149.7	9.97
05/19/85	144.0	19.03
05/20/85	157.3	13.70
05/21/85	164.7	17.80
05/22/85	133.3	18.40
05/23/85	138.3	31.00
05/24/85	186.0	26.00
05/25/85	218.3	16.97
05/26/85	174.3	18.70
05/27/85	205.3	15.60
05/28/85	173.3	18.97
05/29/85	172.7	17.67
05/30/85	206.3	6.00
05/31/85	238.3	7.40
06/01/85	122.7	8.33
06/02/85	191.7	10.67
06/03/85	158.3	9.00
06/04/85	191.0	6.00
06/05/85	216.3	14.03
06/06/85	179.3	11.17
06/07/85		2.93
06/08/85		1.80
06/09/85	248.7	2.03
06/10/85	185.3	5.07
06/11/85	129.0	3.10
06/12/85	170.3	5.00
06/13/85	213.7	3.50
06/14/85	188.7	8.23
06/15/85	176.3	1.77
06/16/85	173.3	1.10
06/17/85	292.7	4.17
06/18/85	294.0	7.97
06/19/85	218.3	12.17
06/20/85	204.0	4.33
06/21/85	199.7	5.33
06/22/85	218.0	10.97
06/23/85	199.3	3.67
06/24/85	190.7	7.20
06/25/85	132.4	4.70
06/26/85	182.0	7.77
06/27/85	274.0	5.97

DATE COD NO3N

06/28/85	269.3	7.03
06/29/85	222.7	6.67
06/30/85	224.7	12.00
07/01/85	293.0	7.67
07/02/85	262.3	14.33
07/03/85	238.7	12.80
07/04/85	263.7	11.70
07/05/85	272.7	3.67
07/06/85	332.7	4.90
07/07/85	258.3	4.30
07/08/85	269.3	7.80
07/09/85	279.0	7.13
07/10/85	227.7	15.67
07/11/85	162.7	17.57
07/12/85	248.7	20.07
07/13/85	230.3	17.43
07/14/85	221.3	17.33
07/15/85	320.0	9.77
07/16/85	286.3	14.63
07/17/85	235.7	20.03
07/18/85	252.0	22.33
07/19/85	312.7	19.67
07/20/85	320.0	13.67
07/21/85	219.7	9.00
07/22/85	302.7	
07/23/85	246.7	
07/24/85	220.0	
07/25/85	263.3	
07/26/85	208.3	
07/27/85	222.7	9.67
07/28/85	175.7	15.33
07/29/85	243.3	15.33
07/30/85	175.7	12.33
07/31/85	168.3	15.00
08/01/85	146.0	6.00
08/02/85	220.7	6.00
08/03/85	191.7	6.67
08/04/85	215.7	5.50
08/05/85	268.7	15.17
08/06/85	194.3	20.63
08/07/85	217.3	14.33
08/08/85	303.7	12.20
08/09/85	221.0	13.07
08/10/85	276.3	12.50
08/11/85	204.3	16.00
08/12/85	217.7	22.27
08/13/85	242.3	21.83
08/14/85	240.3	25.53
08/15/85	245.0	21.00
08/16/85	217.3	13.33

DATE ----	COD ----	NO3N ----	DATE ----	COD ----	NO3N ----
08/17/85	167.7	12.33	10/06/85	253.3	21.57
08/18/85	172.7	12.67	10/07/85	215.0	27.80
08/19/85	191.3	13.33	10/08/85	193.3	26.07
08/20/85	183.0	12.00	10/09/85	199.0	25.13
08/21/85	252.7	12.50	10/10/85	171.0	21.67
08/22/85	176.0	14.33	10/11/85	175.3	17.00
08/23/85	177.0	12.00	10/12/85	249.7	46.13
08/24/85	179.3	11.00	10/13/85	254.3	23.90
08/25/85	245.0	10.00	10/14/85	222.3	
08/26/85	194.7	8.33	10/15/85	230.7	
08/27/85	201.7	10.63	10/16/85	198.7	
08/28/85	245.3	10.80	10/17/85	228.0	
08/29/85	264.7	12.10	10/18/85	229.7	
08/30/85	246	3	10/19/85	287.0	
08/31/85	231.7	9.80	10/20/85	254.3	
09/01/85	180.7	14.37	10/21/85	209	7
09/02/85	185.7	3.00	10/22/85	182.3	12.00
09/03/85	244.3	8.23	10/23/85	198.0	
09/04/85	224.3	15.00	10/24/85	232.7	8.10
09/05/85	323.0	13.53	10/25/85	216.3	7.10
09/06/85	233.0	16.60	10/26/85	183.0	5.53
09/07/85	232.3	9.00	10/27/85	233.7	8.63
09/08/85	226.7	11.87	10/28/85	246.3	8.60
09/09/85	230.7	12.67	10/29/85	266.3	4.27
09/10/85	219.7	7.33	10/30/85	220.0	5.67
09/11/85	200.0	15.80	10/31/85	165.7	6.00
09/12/85	190.7	7.33	11/01/85	162.0	11.10
09/13/85	213.0	17.67	11/02/85	176.3	4.57
09/14/85	226.3	16.33	11/03/85	172.3	7.20
09/15/85	211.7	16.37	11/04/85	219.3	7.77
09/16/85	256.7	11.67	11/05/85	195.3	13.10
09/17/85	224.0	17.00	11/06/85	191.0	9.03
09/18/85	249.0	18.33	11/07/85	196.7	14.33
09/19/85	264.3	37.24	11/08/85	161.7	
09/20/85	355.7	1.33	11/09/85	316.3	6.00
09/21/85	192.3	19.33	11/10/85	256.7	10.00
09/22/85	193.0	14.77	11/11/85	221.3	9.50
09/23/85	231.3	7.33	11/12/85	193.0	17.67
09/24/85	211.7	13.33	11/13/85	147.3	21.50
09/25/85	196.3	10.70	11/14/85	208.0	16.00
09/26/85	174.7	25.33	11/15/85	206.0	18.00
09/27/85	212.3	33.93	11/16/85	238.7	14.67
09/28/85	228.3	25.33	11/17/85	251.0	11.00
09/29/85	174.0	17.87	11/18/85	263.7	7.00
09/30/85	249.3	23.17	11/19/85	297.7	1.33
10/01/85	239.7	22.17	11/20/85	317	1
10/02/85	305.0	34.67	11/21/85	297.0	6.67
10/03/85	271.0	28.17	11/22/85	215.0	11.67
10/04/85	308.3	32.00	11/23/85	198.3	13.00
10/05/85	257.7	22.30			

DATE	COD	NO3N	DATE	COD	NO3N
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11/24/85	213.3	11.33	01/13/86	234.0	2.00
11/25/85	237.3	9.67	01/14/86	297.0	2.33
11/26/85	225.0	12.33	01/15/86	293.0	2.67
11/27/85	247.0	10.67	01/16/86	335.3	8.33
11/28/85	206.7	10.67	01/17/86	326.7	22.00
11/29/85	190.7	11.67	01/18/86	344.0	3.33
11/30/85	154.7	6.67	01/19/86	247.3	3.67
12/01/85	251.7	8.33	01/20/86	270.3	4.00
12/02/85	192.7	7.00	01/21/86	206.0	4.33
12/03/85	207.7	13.33	01/22/86	298.7	4.67
12/04/85	216.7	6.33	01/23/86	357.3	4.67
12/05/85	276.3	11.67	01/24/86	342.3	4.00
12/06/85	230.3	10.00	01/25/86	303.3	4.00
12/07/85	255.7	4.00	01/26/86	286.3	2.67
12/08/85	296.7	1.33	01/27/86	304.3	3.00
12/09/85	242.3	5.00	01/28/86	273.3	3.00
12/10/85	232.0	11.67	01/29/86	230.3	3.67
12/11/85	213.0	13.67	01/30/86	300.7	3.33
12/12/85	253.7	9.67	01/31/86	345.3	3.00
12/13/85	301.0	8.00	02/01/86	342.0	4.00
12/14/85	271.3	8.00	02/02/86	255.0	3.67
12/15/85	292.7	8.00	02/03/86	306.7	3.33
12/16/85	350.0	6.67	02/04/86	287.7	2.33
12/17/85	294.0	1.67	02/05/86	221.0	3.33
12/18/85	259.3	1.67	02/06/86	281.7	2.67
12/19/85	331.3	1.67	02/07/86	264.3	3.00
12/20/85	304.3	2.33	02/08/86	259.7	3.00
12/21/85	273.7	2.33	02/09/86	262.7	3.00
12/22/86	240.0	2.00	02/10/86	218.0	3.33
12/23/86	213.0	2.00	02/11/86	219.0	6.25
12/24/86	348.0	2.33	02/12/86	204.3	5.67
12/25/86	366.0	2.33	02/13/86	201.7	5.67
12/26/86	297.0	3.00	02/14/86	238.7	5.67
12/27/86	203.0	6.33	02/15/86	223.7	4.33
12/28/86	241.0	3.00	02/16/86	246.7	3.67
12/29/86	202.3	2.67	02/17/86	204.7	4.00
12/30/86	212.3	3.00	02/18/86	229.0	3.00
12/31/86	231.3	3.00	02/19/86	250.0	4.00
01/01/86	350.7	3.00	02/20/86	234.0	5.33
01/02/86	240.3	2.67	02/21/86	292.7	3.00
01/03/86	357		02/22/86	251.7	3.33
01/04/86	241.3	1.50	02/23/86	253.0	2.67
01/05/86	284.0	2.00	02/24/86	278.3	2.67
01/06/86	260.7	2.00	02/25/86	312.7	2.33
01/07/86	336.7	2.00	02/26/86	314.7	3.67
01/08/86	261.0	2.67	02/27/86	285.3	2.33
01/09/86	313.3	2.33	02/28/86	335.0	2.33
01/10/86	311.7	2.67	03/01/86	339.7	2.33
01/11/86	262.3	4.00	03/02/86	281.3	1.67
01/12/86	264.3	2.67	03/03/86	253.0	2.00

DATE	COD	NO3N	DATE	COD	NO3N
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03/04/86	263.0	1.50	04/23/86	108.7	18.33
03/05/86	300.3	2.67	04/24/86	182.7	21.67
03/06/86	303.3	2.33	04/25/86	89.3	21.00
03/07/86	281.7	2.00	04/26/86	92.7	6.33
03/08/86	282.3	1.67	04/27/86	66.7	32.67
03/09/86	253.3	1.67	04/28/86	55.0	4.67
03/10/86	250.0	4.67	04/29/86	71.3	11.33
03/11/86	246.3	2.33	04/30/86	84.3	32.33
03/12/86	277.0	3.33	05/01/86	101.0	8.00
03/13/86	240.7	2.00	05/02/86	101.7	32.67
03/14/86	215.3	1.33	05/03/86	143.7	4.00
03/15/86	288.0	2.00	05/04/86	159.3	33
03/16/86	199.3	1.67	05/05/86	141.7	1.33
03/17/86	292.7	2.50	05/06/86	103.3	3.50
03/18/86	257.0	2.50	05/07/86	148.3	22.00
03/19/86	245.0	2.00	05/08/86	141.7	22.33
03/20/86	226.0	2.33	05/09/86	102.0	17.67
03/21/86	210.3	2.00	05/10/86	88.7	16.00
03/22/86	244.3	3.50	05/11/86	94.7	17.67
03/23/86	218.3	3.00	05/12/86	158.7	18.67
03/24/86	236.7	2.67	05/13/86	167.3	18.33
03/25/86	249.7	2.67	05/14/86	79.7	24.33
03/26/86	273.7	2.67	05/15/86	122.5	20.50
03/27/86	207.0	2.33	05/16/86	139.7	15.00
03/28/86	250.3	1.33	05/17/86	82.7	21.67
03/29/86	257.7	2.33	05/18/86	65.7	21.00
03/30/86	312.0	2.00	05/19/86	102.7	14.67
03/31/86	269.7	7.00	05/20/86	75.0	22.33
04/01/86	210.0	18.67	05/21/86	102.7	11.33
04/02/86	153.7	9.67	05/22/86	47	7
04/03/86	203	9			
04/04/86	199.7	6.67	05/30/86	89	14
04/05/86	182.7	6.00	05/31/86	55	13
04/06/86	173.3	6.33	06/01/86	58	12
04/07/86	145.7	7.33	06/02/86	112	15
04/08/86	171.3	4.67	06/03/86	101	14
04/09/86	193.3	2.00	06/04/86	201	13
04/10/86	188.7	2.00	06/05/86	126	12
04/11/86	170.0	2.33	06/06/86	65	19
04/12/86	218.3	1.33	06/07/86	110	6
04/13/86	179.0	1.33	06/08/86	61	16
04/14/86	191.3	1.00	06/09/86	105	7
04/15/86	160.7	1.00	06/10/86	62	19
04/16/86	170.7	1.50	06/11/86	61	18
04/17/86	118.0	3.67	06/12/86	76	15
04/18/86	150.0	6.67	06/13/86	116	3
04/19/86	129.7	11.67	06/14/86	76	4
04/20/86	102.0	12.67	06/15/86	209	6
04/21/86	114.7	12.00	06/16/86	132	7
04/22/86	109.3	14.67	06/17/86	165	7

DATE ----	COD ---	NO3N ----	DATE ----	COD ---	NO3N ----
06/18/86	176	7	08/01/86	230	10
06/19/86	124	9	08/02/86	208	4
06/20/86	248	8	08/03/86	225	2
06/21/86	140	7	08/04/86	165	2
06/22/86	95	6	08/05/86	182	8
06/23/86	95	8	08/06/86	197	4
06/24/86	83	7	08/07/86	166	6
06/25/86	104	4	08/08/86	76	5
06/26/86	94	8	08/09/86	119	8
06/27/86	153	7	08/10/86	93	8
06/28/86	96	4	08/11/86	113	9
06/29/86	103	9	08/12/86	102	9
06/30/86	56	10	08/13/86	106	8
07/01/86	139	11	08/14/86	129	8
07/02/86	118	12	08/15/86	122	11
07/03/86	138	10	08/16/86	106	9
07/04/86	156	8	08/17/86	103	13
07/05/86	131	8	08/18/86	76	15
07/06/86	196	9	08/19/86	88	14
07/07/86	151	10	08/20/86	127	12
07/08/86	135	9	08/21/86	118	
07/09/86	159	9	08/22/86	94	
07/10/86	142	10	08/23/86	160	
07/11/86	143	11	08/24/86	108	
07/12/86	89	18	08/25/86	101	6
07/13/86	66	11	08/26/86	124	6
07/14/86	168	12	08/27/86	91	6
07/15/86	106	11	08/28/86	92	12
07/16/86	91	10	08/29/86	138	18
07/17/86	126	12	08/30/86	73	15
07/18/86	112	19	08/31/86	104	9
07/19/86	237	11			
07/20/86	99	11			
07/21/86	177	8			
07/22/86	161	9			
07/23/86	155	12			
07/24/86	133	12			
07/25/86	106	14			
07/26/86	95	22			
07/27/86	100	14			
07/28/86	98	14			
07/29/86	105	10			
07/30/86	146	8			
07/31/86	136	10			

APPENDIX E

Aerobic Filter Effluent: Daily Average COD (mg/L)
(Blank spaces indicate data not collected.)

DATE	COD	DATE	COD	DATE	COD
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06/29/83	22	08/16/83	62	10/03/83	21
06/30/83	38	08/17/83	69	10/04/83	26
07/01/83	32	08/18/83	39	10/05/83	32
07/02/83	92	08/19/83	41	10/06/83	22
07/03/83	25	08/20/83	5	10/07/83	17
07/04/83	40	08/21/83	20	10/08/83	26
07/05/83	172	08/22/83		10/09/83	26
07/06/83	22	08/23/83		10/10/83	26
07/07/83	47	08/24/83	194	10/11/83	15
07/08/83	33	08/25/83	19	10/12/83	8
07/09/83	62	08/26/83	166	10/13/83	8
07/10/83	21	08/27/83	99	10/14/83	12
07/11/83	16	08/28/83	106	10/15/83	29
07/12/83	29	08/29/83	35	10/16/83	16
07/13/83	29	08/30/83	184	10/17/83	38
07/14/83	114	08/31/83		10/18/83	31
07/15/83	27	09/01/83	68	10/19/83	57
07/16/83	44	09/02/83	57	10/20/83	27
07/17/83	29	09/03/83	235	10/21/83	57
07/18/83	25	09/04/83	23	10/22/83	19
07/19/83	25	09/05/83	27	10/23/83	54
07/20/83	20	09/06/83	0	10/24/83	177
07/21/83	33	09/07/83	30	10/25/83	14
07/22/83	39	09/08/83		10/26/83	
07/23/83	50	09/09/83	41	10/27/83	36
07/24/83	60	09/10/83	40	10/28/83	51
07/25/83	93	09/11/83	96	10/29/83	39
07/26/83	89	09/12/83	26	10/30/83	54
07/27/83	166	09/13/83	73	10/31/83	31
07/28/83	64	09/14/83	95	11/01/83	57
07/29/83	112	09/15/83	69	11/02/83	113
07/30/83	63	09/16/83	38	11/03/83	59
07/31/83		09/17/83	4	11/04/83	38
08/01/83	91	09/18/83	29	11/05/83	55
08/02/83	102	09/19/83	10	11/06/83	46
08/03/83	50	09/20/83	4	11/07/83	89
08/04/83	28	09/21/83	11	11/08/83	68
08/05/83	34	09/22/83	23	11/09/83	94
08/06/83		09/23/83	16	11/10/83	122
08/07/83		09/24/83	16	11/11/83	71
08/08/83		09/25/83	42	11/12/83	79
08/09/83		09/26/83	8	11/13/83	72
08/10/83		09/27/83	79	11/14/83	100
08/11/83	35	09/28/83	12	11/15/83	75
08/12/83		09/29/83	53	11/16/83	128
08/13/83	76	09/30/83	7	11/17/83	86
08/14/83	77	10/01/83	36	11/18/83	97
08/15/83	46	10/02/83	19	11/19/83	64

DATE	COD	DATE	COD	DATE	COD
11/20/83	35	01/07/84	108	02/24/84	60
11/21/83	35	01/08/84	246	02/25/84	49
11/22/83	26	01/09/84	127	02/26/84	68
11/23/83	45	01/10/84	124	02/27/84	73
11/24/83	30	01/11/84	88	02/28/84	112
11/25/83	41	01/12/84	129	02/29/84	94
11/26/83	36	01/13/84	86	03/01/84	98
11/27/83	65	01/14/84	70	03/02/84	143
11/28/83	42	01/15/84	94	03/03/84	136
11/29/83	48	01/16/84	144	03/04/84	120
11/30/83	70	01/17/84	143	03/05/84	97
12/01/83	31	01/18/84	122	03/06/84	87
12/02/83	35	01/19/84	65	03/07/84	116
12/03/83	95	01/20/84	71	03/08/84	130
12/04/83	93	01/21/84	101	03/09/84	115
12/05/83	81	01/22/84	93	03/10/84	106
12/06/83	47	01/23/84	85	03/11/84	101
12/07/83	57	01/24/84	119	03/12/84	84
12/08/83	50	01/25/84	125	03/13/84	84
12/09/83	70	01/26/84	104	03/14/84	81
12/10/83	84	01/27/84	130	03/15/84	77
12/11/83	74	01/28/84	139	03/16/84	103
12/12/83	178	01/29/84	87	03/17/84	204
12/13/83	48	01/30/84	110	03/18/84	171
12/14/83	249	01/31/84	96	03/19/84	138
12/15/83	76	02/01/84	100	03/20/84	176
12/16/83	61	02/02/84	189	03/21/84	193
12/17/83	90	02/03/84	100	03/22/84	211
12/18/83	65	02/04/84	85	03/23/84	102
12/19/83	47	02/05/84	120	03/24/84	140
12/20/83	39	02/06/84	81	03/25/84	139
12/21/83	102	02/07/84	44	03/26/84	122
12/22/83	79	02/08/84	501	03/27/84	110
12/23/83	84	02/09/84	78	03/28/84	160
12/24/83	84	02/10/84	74	03/29/84	91
12/25/83	130	02/11/84	142	03/30/84	102
12/26/83	97	02/12/84	153	03/31/84	148
12/27/83	60	02/13/84	88	04/01/84	77
12/28/83	73	02/14/84	67	04/02/84	144
12/29/83	100	02/15/84	81	04/03/84	142
12/30/83	131	02/16/84	82	04/04/84	101
12/31/83	93	02/17/84	88	04/05/84	108
01/01/84	98	02/18/84	88	04/06/84	61
01/02/84	107	02/19/84	83	04/07/84	141
01/03/84	119	02/20/84	54	04/08/84	124
01/04/84	182	02/21/84	129	04/09/84	101
01/05/84	127	02/22/84	78	04/10/84	117
01/06/84	106	02/23/84	88	04/11/84	164

DATE	COD	DATE	COD	DATE	COD
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04/12/84	152	05/30/84	64	07/17/84	12
04/13/84	175	05/31/84	60	07/18/84	42
04/14/84	151	06/01/84	53	07/19/84	43
04/15/84	174	06/02/84	86	07/20/84	48
04/16/84	104	06/03/84	18	07/21/84	53
04/17/84	105	06/04/84	79	07/22/84	86
04/18/84	113	06/05/84	86	07/23/84	49
04/19/84	184	06/06/84	74	07/24/84	42
04/20/84	113	06/07/84	64	07/25/84	55
04/21/84	77	06/08/84	54	07/26/84	46
04/22/84	78	06/09/84	81	07/27/84	41
04/23/84	135	06/10/84	75	07/28/84	31
04/24/84	66	06/11/84	49	07/29/84	36
04/25/84	56	06/12/84	70	07/30/84	55
04/26/84	51	06/13/84	104	07/31/84	49
04/27/84	57	06/14/84	94	08/01/84	58
04/28/84	91	06/15/84	48	08/02/84	44
04/29/84	71	06/16/84	56	08/03/84	64
04/30/84	172	06/17/84	51	08/04/84	68
05/01/84	72	06/18/84	66	08/05/84	55
05/02/84	94	06/19/84	73	08/06/84	73
05/03/84	112	06/20/84	65	08/07/84	41
05/04/84	72	06/21/84	68	08/08/84	276
05/05/84	53	06/22/84	146	08/09/84	58
05/06/84	68	06/23/84	213	08/10/84	140
05/07/84	30	06/24/84	87	08/11/84	34
05/08/84	68	06/25/84	67	08/12/84	44
05/09/84	48	06/26/84	81	08/13/84	54
05/10/84	118	06/27/84	46	08/14/84	43
05/11/84	88	06/28/84	71	08/15/84	41
05/12/84	208	06/29/84	89	08/16/84	41
05/13/84	72	06/30/84	74	08/17/84	55
05/14/84	72	07/01/84	87	08/18/84	93
05/15/84	69	07/02/84	78	08/19/84	34
05/16/84	77	07/03/84	70	08/20/84	39
05/17/84	77	07/04/84	74	08/21/84	54
05/18/84	92	07/05/84	61	08/22/84	52
05/19/84	64	07/06/84	58	08/23/84	60
05/20/84	56	07/07/84	92	08/24/84	37
05/21/84	76	07/08/84	74	08/25/84	45
05/22/84	69	07/09/84	52	08/26/84	86
05/23/84	88	07/10/84	67	08/27/84	64
05/24/84	120	07/11/84	170	08/28/84	41
05/25/84	66	07/12/84	49	08/29/84	22
05/26/84	65	07/13/84	61		
05/27/84	69	07/14/84	60		
05/28/84	57	07/15/84	63		
05/29/84	73	07/16/84	56		

APPENDIX G

Aeration Basin 5: Daily Average Parameters (mg/L)
(Blank spaces indicate data not collected.)

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
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10/27/84	878.7	664.7	61.00	12/16/84	1766.7	1256.7	69.33
10/28/84	973.3	720.0	60.33	12/17/84	1804.0	1164.0	65.67
10/29/84	996.0	630.0	56.67	12/18/84	1800.7	1361.3	65.00
10/30/84	880.0	586.7	56.67	12/19/84	1748.7	1018.0	66.67
10/31/84	710.0	573.3	54.33	12/20/84	1642.7	1087.3	67.33
11/01/84	686.7	440.0	55.67	12/21/84	1598.7	1016.7	66.33
11/02/84	516.7	312.0	60.33	12/22/84	1547.3	1094.7	70.00
11/03/84	750.0	626.7	58.33	12/23/84	1600.0	1006.7	64.00
11/04/84	722.0	426.0	62.00	12/24/84	1558.7	1038.7	70.00
11/05/84	800.0	716.7	62.00	12/25/84	1436.7	988.0	68.33
11/06/84	640.0	448.7	73.00	12/26/84	1380.0	976.7	71.33
11/07/84	740.0	530.0	57.33	12/27/84	1403.3	1066.7	70.67
11/08/84	752.7	579.3	60.67	12/28/84	1383.3	984.0	71.67
11/09/84	833.3	600.0	60.00	12/29/84	1660.0	1306.7	60.33
11/10/84	806.7	616.7	61.00	12/30/84	1394.0	1039.3	72.33
11/11/84	799.3	604.0	61.67	12/31/84	1413.3	1070.0	70.67
11/12/84	873.3	633.3	58.00	01/01/85	1496.0	1012.0	68.67
11/13/84	974.0	632.7	59.00	01/02/85	1376.7	1003.3	74.67
11/14/84	876.7	583.3	59.00	01/03/85	3047.5	1982.6	69.33
11/15/84	879.3	572.0	64.67	01/04/85	1516.7	1120.0	69.00
11/16/84	1096.7	870.0	56.67	01/05/85	1468.0	1055.3	70.67
11/17/84	1093.3	763.3	52.67	01/06/85	1510.0	1133.3	69.00
11/18/84	1103.3	866.7	55.67	01/07/85	1531.3	1137.3	73.00
11/19/84	1496.7	963.3	56.33	01/08/85	1546.7	1183.3	71.33
11/20/84	1183.3	793.3	75.67	01/09/85	1534.0	1179.3	71.00
11/21/84	840.0	594.0	59.33	01/10/85	1833.3	1450.0	64.00
11/22/84	1573.3	1060.0	63.33	01/11/85	1746.7	1396.7	67.33
11/23/84	1428.7	960.0	68.00	01/12/85	1736.7	1253.3	66.67
11/24/84	1243.3	856.7	66.33	01/13/85	1646.7	1330.0	67.00
11/25/84	1312.0	942.0	67.67	01/14/85	1750.0	1353.3	67.00
11/26/84	1320.0	1003.3	64.00	01/15/85	1750.0	1333.3	65.33
11/27/84	1390.0	1003.3	59.00	01/16/85	1830.0	1436.7	66.67
11/28/84	1526.0	1124.0	56.67	01/17/85	1816.3	1384.0	64.67
11/29/84	1466.7	936.0	59.67	01/18/85	1843.3	1453.3	63.67
11/30/84	1587.3	1040.0	57.33	01/19/85	1918.7	1513.3	65.33
12/01/84	1404.0	1052.0	66.67	01/20/85	1906.7	1593.3	65.67
12/02/84	1614.0	1216.0	56.67	01/21/85	1848.7	1472.7	66.33
12/03/84	1692.7	1236.7	59.33	01/22/85	1923.3	1523.3	58.00
12/04/84	2289.3	1320.7	45.33	01/23/85	1890.0	1533.3	54.33
12/05/84	2260.0	1716.7	48.67	01/24/85	2092.0	1689.3	58.33
12/06/84	2386.7	1543.3	48.33	01/25/85	2066.0	1659.3	55.33
12/07/84	2238.0	1307.3	50.67	01/26/85	1924.7	1599.3	58.33
12/08/84	2379.3	1266.0	51.33	01/27/85	2045.0	1599.7	56.33
12/09/84	1986.7	1308.0	57.67	01/28/85	1902.7	1542.0	67.00
12/10/84	1895.3	1298.7	61.33	01/29/85	1920.7	1583.3	59.00
12/11/84	1868.0	1269.3	61.33	01/30/85	1806.7	1494.7	63.00
12/12/84	1614.7	1006.7	69.00	01/31/85	1770.0	1546.7	59.00
12/13/84	1866.7	1215.3	59.67	02/01/85	1800.0	1493.3	62.33
12/14/84	1990.0	1093.3	59.00	02/02/85	1863.3	1573.3	62.00
12/15/84	1872.7	1326.0	67.00	02/03/85	2019.3	1622.7	63.00

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
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02/04/85	1920.0	1473.3	62.33	03/26/85	2650.0	1983.3	102.3
02/05/85	1918.7	1589.3	65.67	03/27/85	2450.0	1870.0	100.3
02/06/85	1753.3	1373.3	71.33	03/28/85	2810.0	2036.7	96.00
02/07/85	1918.0	1548.0	65.33	03/29/85	2846.7	2046.7	103.0
02/08/85	2006.7	1723.3	68.67	03/30/85	2790.0	2020.0	99.00
02/09/85	2280.0	2260.0	66.00	03/31/85	2196.7	1646.7	97.67
02/10/85	1926.7	1596.7	73.67	04/01/85	2163.3	1580.0	106.0
02/11/84	860	730	64	04/02/85	2460.0	1763.3	106.3
02/12/85	2336.7	1890.0	75.00	04/03/85	2536.7	1856.7	110.3
02/13/85	2047.3	1696.7	81.00	04/04/85	1679.7	1883.3	101.7
02/14/85	2023.3	1710.0	82.00	04/05/85	2386.7	1746.7	107.7
02/15/85	2075.3	1767.3	87.33	04/06/85	2470.0	1836.7	101.0
02/16/85	2017.3	1666.7	83.33	04/07/85	2323.3	1660.0	104.7
02/17/85	2149.3	1747.3	82.00	04/08/85	2270.0	1643.3	105.0
02/18/85	2060.0	1550.7	87.67	04/09/85	1680.0	1270.0	101.0
02/19/85	1930.0	1650.0	99.00	04/10/85	2180.0	1543.3	101.3
02/20/85	2136.7	1750.0	96.67	04/11/85	2086.7	1583.3	98.67
02/21/85	1990.0	1673.3	105.7	04/12/85	2126.7	1613.3	94.33
02/22/85	2133.3	1796.7	103.0	04/13/85	1973.3	1620.0	96.00
02/23/85	2130.0	1786.7	110.7	04/14/85	2003.3	1536.7	90.00
02/24/85	2123.3	1793.3	111.3	04/15/85	2043.3	1630.0	90.67
02/25/85	1996.7	1703.3	109.7	04/16/85	2143.3	1626.7	86.33
02/26/85	1976.7	1620.0	112.7	04/17/85	2200.0	1676.7	81.67
02/27/85	1986.7	1440.0	112.3	04/18/85	2166.7	1613.3	80.00
02/28/85	1993.3	1790.0	108.7	04/19/85	2303.3	1760.0	72.33
03/01/85	1993.3	1616.7	107.3	04/20/85	2398.7	1636.0	69.67
03/02/85	2196.7	1880.0	109.3	04/21/85	2070.0	1493.3	69.67
03/03/85	2090.0	1813.3	119.7	04/22/85	1790.0	1333.3	78.00
03/04/85	2030.0	1813.3	115.0	04/23/85	1810.0	1330.0	72.33
03/05/85	1980.0	1703.3	118.7	04/24/85	1776.7	1293.3	71.33
03/06/85	1513.3	1270.0	109.3	04/25/85	1760.0	1303.3	68.33
03/07/85	2600.0	2262.5	102.3	04/26/85	1803.3	1270.0	64.00
03/08/85	2676.7	2246.7	125.7	04/27/85	1863.3	1286.7	60.00
03/09/85	2890.0	2303.3	121.0	04/28/85	1763.3	1220.0	61.33
03/10/85	2903.3	2236.7	125.0	04/29/85	1703.3	1183.3	61.00
03/11/85	2360.0	1906.7	120.0	04/30/85	1596.7	1140.0	69.33
03/12/85	1918.7	1636.7	102.3	05/01/85	1630.0	1143.3	65.33
03/13/85	1803.3	1553.3	115.7	05/02/85	1733.3	1236.7	49.67
03/14/85	2488.3	1981.7	110.3	05/03/85	1746.7	1226.7	68.33
03/15/85	2100.0	1740.0	134.0	05/04/85	1670.0	1000.0	68.67
03/16/85	2436.7	1883.3	118.3	05/05/85	1816.7	1210.0	61.33
03/17/85	2640.0	2120.0	103.3	05/06/85	1880.0	1176.7	54.33
03/18/85	2733.3	2083.3	110.3	05/07/85	1936.7	1346.7	55.33
03/19/85	2370.0	1903.3	136.7	05/08/85	1965.0	1296.7	53.67
03/20/85	2506.7	2183.3	107.7	05/09/85	1936.7	1270.0	53.67
03/21/85	2926.7	2280.0	103.3	05/10/85	1853.3	1166.7	58.33
03/22/85	2853.3	2166.7	105.3	05/11/85	1806.7	1190.0	57.00
03/23/85	2973.3	2260.0	104.3	05/12/85	1670.0	1120.0	59.33
03/24/85	2820.0	2156.7	98.00	05/13/85	1620.0	1120.0	59.33
03/25/85	2693.3	2023.3	101.7	05/14/85	1533.3	1046.7	60.00

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
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05/15/85	1710.0	1086.7	53.00	07/04/85	1953.3	1356.7	47.33
05/16/85	1730.0	1116.7	55.00	07/05/85	1956.7	1380.0	49.67
05/17/85	1613.3	1030.0	61.67	07/06/85	2003.3	1440.0	50.33
05/18/85	1710.0	1083.3	58.00	07/07/85	2030.0	1453.3	51.00
05/19/85	1773.3	1176.7	54.33	07/08/85	2083.3	1563.3	55.00
05/20/85	1446.7	966.7	56.67	07/09/85	2216.7	1650.0	54.33
05/21/85	1360.0	963.3	54.33	07/10/85	2380.0	1703.3	53.33
05/22/85	1363.3	1000.0	52.33	07/11/85	2806.7	1846.7	54.00
05/23/85	1370.0	980.0	51.33	07/12/85	1803.3	1126.7	49.00
05/24/85	1436.7	1043.3	49.33	07/13/85	3210.0	2096.7	53.00
05/25/85	1510.0	1066.7	53.00	07/14/85	2470.0	1583.3	55.00
05/26/85	1440.0	1010.0	55.67	07/15/85	2076.7	1316.7	57.00
05/27/85	1443.3	1000.0	51.00	07/16/85	3033.3	1883.3	57.00
05/28/85	1363.3	1050.0	51.33	07/17/85	2903.3	1800.0	59.67
05/29/85	1346.7	986.7	52.00	07/18/85	2890.0	1876.7	59.33
05/30/85	1333.3	930.0	50.00	07/19/85	3146.7	1873.3	54.33
05/31/85	1390.0	946.7	50.00	07/20/85	2923.3	1800.0	60.67
06/01/85	1440.0	963.3	47.67	07/21/85	2800.0	1870.0	62.67
06/02/85	1386.7	1003.3	50.33	07/22/85	2663.3	1720.0	64.67
06/03/85	1393.3	986.7	50.00	07/23/85	2670.0	1760.0	66.00
06/04/85	1343.3	956.7	49.33	07/24/85	2483.3	1613.3	66.33
06/05/85	1230.0	860.0	52.00	07/25/85	2333.3	1560.0	68.67
06/06/85	1303.3	840.0	52.33	07/26/85	2420.0	1630.0	62.00
06/07/85	1520.0	1046.7	48.67	07/27/85	2360.0	1603.3	61.33
06/08/85	1436.7	1033.3	53.00	07/28/85	2410.0	1630.0	63.33
06/09/85	1406.7	1003.3	52.33	07/29/85	2500.0	1780.0	60.33
06/10/85	1436.7	1033.3	52.67	07/30/85	2656.7	1670.0	60.00
06/11/85	1230.0	866.7	51.67	07/31/85	2413.3	1600.0	60.00
06/12/85	1170.0	886.7	52.00	08/01/85	2506.7	1823.3	59.67
06/13/85	1273.3	913.3	55.67	08/02/85	2500.0	1446.7	60.67
06/14/85	1140.0	820.0	57.00	08/03/85	2566.7	1573.3	60.33
06/15/85	1036.7	750.0	52.33	08/04/85	2443.3	1526.7	64.33
06/16/85	1093.3	786.7	63.33	08/05/85	2520.0	1513.3	62.67
06/17/85	1353.3	993.3	52.00	08/06/85	2916.7	1700.0	58.33
06/18/85	1433.3	1070.0	53.33	08/07/85	2633.3	1553.3	56.67
06/19/85	1593.3	1130.0	52.33	08/08/85	2500.0	1536.7	58.33
06/20/85	1863.3	1316.7	50.33	08/09/85	2466.7	1513.3	58.00
06/21/85	1813.3	1310.0	52.67	08/10/85	2393.3	1486.7	57.67
06/22/85	1786.7	1273.3	54.33	08/11/85	2180.0	1140.0	59.33
06/23/85	1696.7	1183.3	55.00	08/12/85	2126.7	1126.7	57.33
06/24/85	1703.3	1213.3	54.00	08/13/85	2053.3	1383.3	58.67
06/25/85	1606.7	1140.0	54.67	08/14/85	2593.3	1660.0	56.33
06/26/85	1696.7	1260.0	46.33	08/15/85	2766.7	1773.3	58.00
06/27/85	1776.7	1226.7	47.33	08/16/85	2750.0	1773.3	60.00
06/28/85	1813.3	1286.7	44.33	08/17/85	2553.3	1670.0	58.67
06/29/85	2076.7	1456.7	42.67	08/18/85	2590.0	1686.7	58.67
06/30/85	1716.7	1220.0	44.33	08/19/85	2436.7	1583.3	58.00
07/01/85	1560.0	1153.3	42.67	08/20/85	2320.0	1536.7	57.33
07/02/85	1770.0	1296.7	44.00	08/21/85	2356.7	1540.0	56.67
07/03/85	1893.3	1360.0	46.67	08/22/85	1736.7	1150.0	57.00

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
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08/23/85	1303.3	883.3	74.67	10/12/85	2216.7	1510.0	68.67
08/24/85	2210.0	1463.3	59.00	10/13/85	2090.0	1490.0	72.67
08/25/85	2070.0	1423.3	63.00	10/14/85	1900.0	1436.7	80.00
08/26/85	2106.7	1490.0	60.67	10/15/85	2076.7	1536.7	72.67
08/27/85	1930.0	1276.7	60.67	10/16/85	2156.7	1483.3	73.33
08/28/85	1823.3	1310.0	63.00	10/17/85	1920.0	1390.0	81.00
08/29/85	1856.7	1256.7	58.33	10/18/85	2040.0	1526.7	82.33
08/30/85	1720.0	1256.7	56.33	10/19/85	2030.0	1503.3	79.00
08/31/85	1706.7	1223.3	61.00	10/20/85	1890.0	1453.3	84.00
09/01/85	1700.0	1280.0	55.33	10/21/85	1776.7	1356.7	90.33
09/02/85	1583.3	1163.3	59.00	10/22/85	1883.3	1443.3	87.67
09/03/85	1616.7	1183.3	57.33	10/23/85	1823.3	1343.3	86.67
09/04/85	1740.0	1216.7	55.67	10/24/85	1793.3	1330.0	85.67
09/05/85	1676.7	956.7	63.00	10/25/85	1656.7	1163.3	84.33
09/06/85	1763.3	1263.3	62.67	10/26/85	1380	1180	94
09/07/85	1866.7	1316.7	58.33	10/27/85	1436.7	1066.7	86.00
09/08/85	1796.7	1263.3	61.33	10/28/85	1346.7	1060.0	94.67
09/09/85	1780.0	1380.0	64.33	10/29/85	1350.0	1030.0	92.00
09/10/85	1860.0	1330.0	63.33	10/30/85	1456.7	1193.3	82.33
09/11/85	1783.3	1300.0	67.67	10/31/85	1413.3	1126.7	87.67
09/12/85	1737.5	1250.0	69.00	11/01/85	1430.0	1130.0	89.00
09/13/85	1683.3	1263.3	75.00	11/02/85	1480.0	1106.7	86.67
09/14/85	1633.3	1173.3	77.67	11/03/85	1423.3	1113.3	87.67
09/15/85	1673.3	1293.3	76.67	11/04/85	1446.7	1060.0	88.33
09/16/85	1620.0	1230.0	83.00	11/05/85	1476.7	1100.0	87.67
09/17/85	1735.0	1347.5	83.67	11/06/85	1340.0	1003.3	93.00
09/18/85	1693.3	1290.0	82.67	11/07/85	1386.7	1043.3	87.33
09/19/85	1613.3	1236.7	88.00	11/08/85	1393.3	1116.7	86.00
09/20/85	1760.0	1356.7	83.33	11/09/85	1480.0	1150.0	81.33
09/21/85	1796.7	1363.3	81.67	11/10/85	1430.0	1143.3	82.33
09/22/85	1646.7	1316.7	89.33	11/11/85	1393.3	1136.7	91.67
09/23/85	1706.7	1206.7	85.33	11/12/85	1443.3	1133.3	91.00
09/24/85	1680.0	1203.3	81.00	11/13/85	1510.0	1153.3	89.67
09/25/85	1840.0	1393.3	79.00	11/14/85	1490.0	1153.3	90.67
09/26/85	1933.3	1316.7	73.33	11/15/85	1510.0	1116.7	92.33
09/27/85	1980.0	1406.7	73.00	11/16/85	1603.3	1203.3	87
09/28/85	1866.7	1356.7	78.00	11/17/85	1643.3	1280.0	87
09/29/85	1890.0	1360.0	68.33	11/18/85	1706.7	1306.7	85
09/30/85	1710.0	1190.0	75.33	11/19/85	1690.0	1286.7	88
10/01/85	1713.3	1216.7	72.67	11/20/85	1703.3	1220.0	88
10/02/85	1756.7	1253.3	72.00	11/21/85	1826.7	1450.0	87
10/03/85	2323.3	1476.7	64.00	11/22/85	1820.0	1490.0	92
10/04/85	2616.7	1703.3	61.33	11/23/85	1920.0	1536.7	97
10/05/85	2613.3	1720.0	62.33	11/24/85	1926.7	1473.3	99
10/06/85	2576.7	1786.7	63.00	11/25/85	1826.7	1436.7	92
10/07/85	2380.0	1593.3	68.67	11/26/85	1746.7	1333.3	93
10/08/85	2000.0	1560.0	68.00	11/27/85	1876.7	1486.7	85
10/09/85	2280.0	1533.3	68.33	11/28/85	1806.7	1446.7	80
10/10/85	2390.0	1633.3	67.00	11/29/85	1626.7	1306.7	84
10/11/85	2093.3	1340.0	71.67	11/30/85	1596.7	1236.7	78

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
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12/01/85	1703.3	1330.0	75	01/20/86	1640.0	1423.3	111
12/02/85	1693.3	1306.7	74	01/21/86	1810.0	1550.0	108
12/03/85	1690.0	1323.3	71	01/22/86	1653.3	1453.3	109
12/04/85	1660.0	1303.3	72	01/23/86	1616.7	1453.3	104
12/05/85	1550.0	1230.0	76	01/24/86	1736.7	1543.3	103
12/06/85	1686.7	1316.7	73	01/25/86	1706.7	1476.7	108
12/07/85	1806.7	1390.0	68	01/26/86	1703.3	1360.0	108
12/08/85	1726.7	1370.0	69	01/27/86	1670.0	1523.3	105
12/09/85	1640.0	1356.7	71	01/28/86	1676.7	1506.7	99
12/10/85	1706.7	1430.0	65	01/29/86	1560.0	1406.7	105
12/11/85	1753.3	1443.3	64	01/30/86	1573.3	1456.7	101
12/12/85	1656.7	1330.0	67	01/31/86	1770.0	1573.3	97
12/13/85	1783.3	1430.0	67	02/01/86	1900.0	1596.7	96
12/14/85	1830.0	1513.3	73	02/02/86	1883.3	1613.3	97
12/15/85	1770.0	1520.0	76	02/03/86	1790.0	1573.3	100
12/16/85	1863.3	1560.0	84	02/04/86	1773.3	1576.7	106
12/17/85	1973.3	1610.0	80	02/05/86	1800.0	1496.7	100
12/18/85	1940.0	1400.0	82	02/06/86	1683.3	1466.7	112
12/19/85	1990.0	1666.7	77	02/07/86	1750.0	1513.3	108
12/20/85	1906.7	1520.0	84	02/08/86	1630.0	1406.7	111
12/21/85	1900.0	1726.7	88	02/09/86	1600.0	1426.7	107
12/22/85	1826.7	1590.0	89	02/10/86	1610.0	1400.0	107
12/23/85	1786.7	1543.3	89	02/11/86	1570.0	1410.0	111
12/24/85	1726.7	1530.0	94	02/12/86	1543.3	1333.3	109
12/25/85	1763.3	1583.3	96	02/13/86	1576.7	1366.7	101
12/26/85	1803.3	1616.7	89	12/14/86	1660.0	1436.7	91
12/27/85	1836.7	1596.7	90	02/15/86	1620.0	1386.7	94
12/28/85	1870.0	1576.7	94	02/16/86	1646.7	1413.3	92
12/29/85	1826.7	1566.7	94	02/17/86	1690.0	1396.7	92
12/30/85	1950.0	1670.0	87	02/18/86	1830.0	1520.0	90
12/31/85	1963.3	1683.3		02/19/86	1716.7	1453.3	92
01/01/86	1996.0	1756.7	94	02/20/86	1723.3	1516.7	95
01/02/86	2070.0	1853.3	92	02/21/86	1836.7	1553.3	90
01/03/86	2026.7	1773.3	93	02/22/86	1886.7	1543.3	87
01/04/86	2030.0	1760.0	95	02/23/86	1896.7	1573.3	93
01/05/86	1856.7	1743.3	98	02/24/86	1896.7	1620.0	96
01/06/86	1646.7	1766.7	97	02/25/86	1866.7	1570.0	100
01/07/86	1936.7	1786.7	95	02/26/86	1846.7	1613.3	106
01/08/86	1973.3	1776.7	89	02/27/86	1940.0	1673.3	107
01/09/86	1806.7	1646.7	94	02/28/86	1816.7	1526.7	120
01/10/86	1803.3	1613.3	100	03/01/86	2036.7	1750.0	112
01/11/86	1773.3	1596.7	101	03/02/86	2003.3	1746.7	116
01/12/86	1706.7	1553.3	105	03/03/86	2000.0	1746.7	121
01/13/86	1480.0	1323.3	110	03/04/86	1973.3	1760.0	125
01/14/86	1633.3	1490.0	111	03/05/86	1993.3	1646.7	122
01/15/86	1616.7	1483.3	117	03/06/86	1983.3	1673.3	120
01/16/86	1676.7	1463.3	113	03/07/86	953.3	1666.7	121
01/17/86	1853.3	1603.3	109	03/08/86	1850.0	1633.3	129
01/18/86	1823.3	1636.7	117	03/09/86	1883.3	1593.3	127
01/19/86	1793.3	1626.7	155	03/10/86	1886.7	1596.7	125

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
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03/11/86	1926.7	1570.0	124	04/30/86	1363.3	946.7	71
03/12/86	2033.3	1653.3	125	05/01/86	1330.0	946.7	68
03/13/86	1903.3	1586.7	126	05/02/86	1386.7	883.3	68
03/14/86	2010.0	1596.7	130	05/03/86	1440.0	930.0	64
03/15/86	1933.3	1593.3	136	05/04/86	1720	990	68
03/16/86	1966.7	1623.3	135	05/05/86	1576.7	1173.3	61
03/17/86	1940.0	1616.7	136	05/06/86	1403.3	1016.7	67
03/18/86	1963.3	1623.3	136	05/07/86	1556.7	1083.3	62
03/19/86	1896.7	1576.7	137	05/08/86	1493.3	1116.7	68
03/20/86	1816.7	1533.3	143	05/09/86	1663.3	1180.0	60
03/21/86	1903.3	1580.0	135	05/10/86	1640.0	1096.7	66
03/22/86	1923.3	1636.7	130	05/11/86	1540.0	1006.7	66
03/23/86	1553.3	1326.7	128	05/12/86	1520.0	1013.3	68
03/24/86	1916.7	1613.3	130	05/13/86	1463.3	1013.3	75
03/25/86	1930.0	1646.7	132	05/14/86	1596.7	1126.7	64
03/26/86	1836.7	1530.0	126	05/15/86	1586.7	1050.0	67
03/27/86	1893.3	1656.7	133	05/16/86	1610.0	1066.7	67
03/28/86	1913.3	1633.3	129	05/17/86	1636.7	1033.3	69
03/29/86	1916.7	1593.3	126	05/18/86	1563.3	1040.0	70
03/30/86	1880.0	1613.3	126	05/19/86	1523.3	980.0	71
03/31/86	1936.7	1676.7	122	05/20/86	1450.0	936.7	72
04/01/86	1893.3	1560.0	124	05/21/86	1387		73
04/02/86	1953.3	1543.3	112	05/22/86	1363		75
04/03/86	1900.0	1580.0	111	05/23/86	1260		78
04/04/86	1970.0	1590.0	100	05/24/86	1257		78
04/05/86	1970.0	1623.3	99	05/25/86	1353		74
04/06/86	1963.3	1573.3	91	05/26/86	1207		82
04/07/86	1660.0	1466.7	79	05/27/86	1273		79
04/08/86	1696.7	1286.7	75	05/28/86	1310		78
04/09/86	1690	1310	63	05/29/86	1463		75
04/10/86	1596.7	1140.0	62	05/30/86	1403		78
04/11/86	1626.7	1210.0	83	05/31/86	1460.0	905.0	75
04/12/86	1556.7	1170.0	71	06/01/86	1456.7	956.7	75
04/13/86	1590.0	1190.0	82	06/02/86	863.3	613.3	74
04/14/86	1446.7	1140.0	95	06/03/86	1480.0	936.7	81
04/15/86	1450.0	1143.3	93	06/04/86	1460.0	970.0	76
04/16/86	1403.3	1103.3	98	06/05/86	1333.3	883.3	81
04/17/86	1506.7	1206.7	93	06/06/86	1386.7	910.0	76
04/18/86	1703.3	1280.0	84	06/07/86	1413.3	900.0	71
04/19/86	1700.0	1226.7	78	06/08/86	1390.0	890.0	75
04/20/86	1710.0	1256.7	78	06/09/86	1406.7	880.0	73
04/21/86	1756.7	1293.3	76	06/10/86	1403.3	883.3	72
04/22/86	1790.0	1230.0	72	06/11/86	1490.0	953.3	69
04/23/86	1703.3	1223.3	73	06/12/86	1410.0	883.3	71
04/24/86	1763.3	1280.0	70	06/13/86	1276.7	723.3	78
04/25/86	1710.0	1226.7	72	06/14/86	1236.7	766.7	75
04/26/86	1613.3	1176.7	73	06/15/86	1116.7	723.3	78
04/27/86	1523.3	1133.3	72	06/16/86	1256.7	803.3	74
04/28/86	1420.0	1053.3	72	06/17/86	576.7	380.0	91
04/29/86	1326.7	910.0	74				

DATE	TSS	VSS	SVI	DATE	TSS	VSS	SVI
06/18/86	1130.0	696.7	72	08/07/86	1306.7	910.0	60
06/19/86	1766.7	1036.7	80	08/08/86	1263.3	916.7	62
06/20/86	1903.3	1330.0	80	08/09/86	1276.7	893.3	62
06/21/86	2080.0	1223.3	77	08/10/86	1300.0	830.0	62
06/22/86	1866.7	1096.7	78	08/11/86	1113.3	833.3	62
06/23/86	1733.3	990.0	75	08/12/86	1096.7	810.0	59
06/24/86	1676.7	963.3	74	08/13/86	1000.0	726.7	57
06/25/86	1500.0	986.7	77	08/14/86	926.7	713.3	60
06/26/86	1396.7	906.7	77	08/15/86	1283.3	796.7	50
06/27/86	1300.0	830.0	75	08/16/86	1406.7	816.7	58
06/28/86	1330.0	893.3	67	08/17/86	1393.3	986.7	57
06/29/86	1266.7	826.7	64	08/18/86	1526.7	973.3	54
06/30/86	1220.0	786.7	61	08/19/86	1636.7	1003.3	51
07/01/86	1220.0	773.3	59	08/20/86	1530.0	923.3	56
07/02/86	1346.7	943.3	52	08/21/86	1403.3	890.0	55
07/03/86	1343.3	950.0	51	08/22/86	1410.0	936.7	55
07/04/86	1263.3	870.0	50	08/23/86	1270.0	840.0	56
07/05/86	1186.7	893.3	50	08/24/86	1133.3	870.0	45
07/06/86	1143.3	813.3	48	08/25/86	1043.3	720.0	61
07/07/86	1100.0	900.0	43	08/26/86	1206.7	800.0	51
07/08/86	1030.0	740.0	34	08/27/86	1256.7	820.0	50
07/09/86	976.7	693.3	29	08/28/86	1253.3	833.3	56
07/10/86	886.7	690.0	33	08/29/86	1310.0	816.7	55
07/11/86	733.3	550.0	42	08/30/86	1176.7	820.0	60.
07/12/86	863.3	613.3	33	08/31/86	1073.3	726.7	67
07/13/86	850.0	596.7	35				
07/14/86	846.7	643.3	38				
07/15/86	876.7	660.0	42				
07/16/86	766.7	580.0	46				
07/17/86	823.3	676.7	45				
07/18/86	730.0	583.3	53				
07/19/86	843.3	613.3	49				
07/20/86	826.7	613.3	58				
07/21/86	1013.3	776.7	55				
07/22/86	1030.0	786.7	55				
07/23/86	980.0	726.7	53				
07/24/86	970.0	736.7	55				
07/25/86	1013.3	670.0	52				
07/26/86	1036.7	736.7	49				
07/27/86	883.3	640.0	52				
07/28/86	866.7	696.7	57				
07/29/86	823.3	546.7	54				
07/30/86	723.3	503.3	51				
07/31/86	713.3	546.7	49				
08/01/86	893.3	556.7	48				
08/02/86	756.7	606.7	49				
08/03/86	796.7	660.0	62				
08/04/86	1040.0	776.7	58				
08/05/86	1190.0	816.7	61				
08/06/86	1273.3	920.0	55				

APPENDIX H

Clarifier Overflow: Daily Average Suspended Solids (mg/L)

DATE	TSS
10/27/84	17.3
10/28/84	14.0
10/29/84	13.3
10/30/84	14.0
10/31/84	12.0
11/01/84	18.7
11/02/84	9.7
11/03/84	10.7
11/04/84	14.0
11/05/84	12.7
11/06/84	10.0
11/07/84	11.0
11/08/84	16.0
11/09/84	13.3
11/10/84	16.7
11/11/84	14.7
11/12/84	21.3
11/13/84	28.7
11/14/84	12.0
11/15/84	15.3
11/16/84	14.0
11/17/84	13.3
11/18/84	20.0
11/19/84	12.7
11/20/84	7.3
11/21/84	14.0
11/22/84	16.0
11/23/84	18.0
11/24/84	14.0
11/25/84	14.7
11/26/84	10.0
11/27/84	12.0
11/28/84	14.7
11/29/84	7.3
11/30/84	18.7
12/01/84	16.0
12/02/84	22.7
12/03/84	20.0
12/04/84	40.0
12/05/84	30.0
12/06/84	63.3
12/07/84	50.0
12/08/84	50.7
12/09/84	32.0
12/10/84	24.0
12/11/84	18.0
12/12/84	10.0
12/13/84	16.0
12/14/84	12.7
12/14/84	10

DATE	TSS
12/15/84	20.7
12/16/84	18.0
12/17/84	10.0
12/18/84	8.7
12/19/84	8.0
12/20/84	21.3
12/21/84	13.3
12/22/84	13.3
12/23/84	15.3
12/24/84	17.3
12/25/84	12.0
12/26/84	14.7
12/27/84	11.3
12/28/84	13.3
12/29/84	12.7
12/30/84	15.3
12/31/84	21.3
01/01/85	26.0
01/02/85	20.7
01/03/85	14.0
01/04/85	14.0
01/05/85	21.7
01/06/85	20.0
01/07/85	14.0
01/08/85	15.3
01/09/85	14.7
01/10/85	24.0
01/11/85	14.7
01/12/85	18.0
01/13/85	13.3
01/14/85	13.7
01/15/85	24.7
01/16/85	14.7
01/16/85	12
01/17/85	13.3
01/18/85	16.7
01/19/85	14.0
01/20/85	14.7
01/21/85	25.3
01/22/85	28.0
01/23/85	15.3
01/24/85	24.7
01/25/85	18.7
01/26/85	32.0
01/27/85	20.0
01/28/85	24.0
01/29/85	29.3
01/30/85	20.0
01/31/85	32.7
02/01/85	24.7

DATE	TSS
02/02/85	26.0
02/03/85	34.0
02/04/85	30.0
02/05/85	20.0
02/06/85	30.0
02/07/85	30.0
02/08/85	26.7
02/09/85	31.3
02/10/85	22.7
02/11/85	27.3
02/12/85	28.0
02/13/85	24.0
02/14/85	26.7
02/15/85	28.7
02/16/85	18.7
02/17/85	30.7
02/18/85	18.0
02/19/85	17.3
02/20/85	19.3
02/21/85	26.7
02/22/85	26.7
02/23/85	31.0
02/24/85	35.3
02/25/85	30.7
02/26/85	36.7
02/27/85	31.3
02/28/85	29.3
03/01/85	20.0
03/02/85	30.7
03/03/85	35.3
03/04/85	26.0
03/05/85	26.0
03/06/85	33.3
03/07/85	28.7
03/08/85	28.0
03/09/85	40.0
03/10/85	15.3
03/11/85	30.7
03/12/85	10.3
03/13/85	18.7
03/14/85	8
03/15/85	14.7
03/16/85	15.0
03/17/85	19.7
03/18/85	26.7
03/19/85	22.0
03/20/85	26.7
03/21/85	17.3
03/22/85	16.0
03/23/85	28.7

DATE	TSS
03/24/85	28.7
03/25/85	27.3
03/26/85	26.7
03/27/85	17.3
03/28/85	19.3
03/29/85	16.0
03/30/85	12.0
03/31/85	18.7
04/01/85	16.7
04/02/85	3.3
04/03/85	16.0
04/04/85	13.3
04/05/85	13.3
04/06/85	8.7
04/07/85	9.3
04/08/85	5.3
04/09/85	11.3
04/10/85	3.3
04/11/85	13.3
04/12/85	7.3
04/13/85	2.7
04/14/85	5.3
04/15/85	4.0
04/16/85	10.7
04/17/85	2.7
04/18/85	8.7
04/19/85	12.0
04/20/85	11.7
04/21/85	13.3
04/22/85	10.7
04/23/85	8.7
04/24/85	10.7
04/25/85	10.7
04/26/85	13.3
04/27/85	16.0
04/28/85	22.7
04/29/85	12.7
04/30/85	12.0
05/01/85	12.7
05/02/85	8.7
05/03/85	8.0
05/04/85	8.0
05/05/85	16.0
05/06/85	16.0
05/07/85	22.0
05/08/85	27.3
05/09/85	20.7
05/10/85	12.7
05/11/85	16.0
05/12/85	15.3

DATE	TSS
-----	-----
05/13/85	12.7
05/14/85	10.7
05/15/85	8.0
05/16/85	22.0
05/17/85	15.3
05/18/85	19.3
05/19/85	25.3
05/20/85	12.7
05/21/85	21.3
05/22/85	27.3
05/23/85	10.0
05/24/85	21.3
05/25/85	18.7
05/26/85	15.3
05/27/85	13.3
05/28/85	17.3
05/29/85	16.7
05/30/85	13.3
05/31/85	14.7
06/01/85	14.7
06/02/85	16.7
06/03/85	15.3
06/04/85	17.3
06/05/85	16.7
06/06/85	13.3
06/07/85	18.7
06/08/85	12.7
06/09/85	8.7
06/10/85	8.7
06/11/85	13.3
06/12/85	6.0
06/13/85	10.0
06/14/85	4.7
06/15/85	9.3
06/16/85	7.3
06/17/85	11.3
06/18/85	14.7
06/19/85	9.3
06/20/85	8
06/21/85	10.0
06/22/85	17.3
06/23/85	10.7
06/24/85	17.3
06/25/85	14.0
06/26/85	10.7
06/27/85	8.7
06/28/85	20.7
06/29/85	14.0
06/30/85	22.7
07/01/85	18.7

DATE	TSS
-----	-----
07/02/85	13.3
07/03/85	20.0
07/04/85	11.3
07/05/85	10.7
07/06/85	6.7
07/07/85	7.3
07/08/85	7.3
07/09/85	7.3
07/10/85	12.7
07/11/85	9.3
07/12/85	20.7
07/13/85	22.0
07/14/85	9.3
07/15/85	22.0
07/16/85	14.0
07/17/85	14.0
07/18/85	16.7
07/19/85	17.3
07/20/85	10.0
07/21/85	12.0
07/22/85	10.7
07/23/85	12.0
07/24/85	10.7
07/25/85	12.0
07/26/85	10.7
07/27/85	18.0
07/28/85	12.7
07/29/85	15.0
07/30/85	16.7
07/31/85	18.7
08/01/85	16.7
08/02/85	12.0
08/03/85	14.0
08/04/85	11.3
08/05/85	12.7
08/06/85	17.0
08/07/85	19.3
08/08/85	16.0
08/09/85	10.0
08/10/85	11.3
08/11/85	12.7
08/12/85	14.0
08/13/85	13.3
08/14/85	22.0
08/15/85	14.0
08/16/85	17.0
08/17/85	14.0
08/18/85	16.7
08/19/85	24.7
08/20/85	11.3

DATE	TSS	DATE	TSS
08/21/85	14.7	10/10/85	22.7
08/22/85	17.3	10/11/85	14.7
08/23/85	16.0	10/12/85	13.3
08/24/85	9.3	10/13/85	18.0
08/25/85	10.7	10/14/85	9.3
08/26/85	20.0	10/15/85	11.3
08/27/85	16.0	10/16/85	14.7
08/28/85	9.3	10/17/85	10.7
08/29/85	14.0	10/18/85	11.3
08/30/85	13.3	10/19/85	11.3
08/31/85	11.3	10/20/85	8.7
09/01/85	11.3	10/21/85	10.0
09/02/85	10.7	10/22/85	5.3
09/03/85	8.7	10/23/85	10.0
09/04/85	6.7	10/24/85	6.7
09/05/85	10.7	10/25/85	6.7
09/06/85	18.7	10/26/85	6.7
09/07/85	17.3	10/27/85	7.3
09/08/85	14.7	10/28/85	6.7
09/09/85	13.3	10/29/85	7.3
09/10/85	14.7	10/30/85	17.3
09/11/85	14.7	10/31/85	8.0
09/12/85	18.7	11/01/85	10.7
09/13/85	5.7	11/02/85	7.7
09/14/85	7.3	11/03/85	10.0
09/15/85	13.3	11/04/85	9.3
09/16/85	15.3	11/05/85	14.0
09/17/85	15.3	11/06/85	9.3
09/18/85	14.0	11/07/85	8.7
09/19/85	4.7	11/08/85	10.0
09/20/85	10.7	11/09/85	11.3
09/21/85	11.3	11/10/85	7.3
09/22/85	8.0	11/11/85	8.0
09/23/85	6.0	11/12/85	4.0
09/24/85	8.0	11/13/85	5.3
09/25/85	10.7	11/14/85	7.3
09/26/85	10.0	11/15/85	6.7
09/27/85	14.7	11/16/85	7.3
09/28/85	10.0	11/17/85	6.0
09/29/85	11.3	11/18/85	10.0
09/30/85	11.3	11/19/85	16.7
10/01/85	10.0	11/20/85	10.7
10/02/85	12.0	11/21/85	10.7
10/03/85	20.0	11/22/85	12.7
10/04/85	17.3	11/23/85	13.3
10/05/85	12.7	11/24/85	10.7
10/06/85	16.0	11/25/85	11.3
10/07/85	12.0	11/26/85	10.0
10/08/85	12.7	11/27/85	18.0
10/09/85	10.7	11/28/85	15.3

DATE	TSS	DATE	TSS
11/29/85	12.0	01/18/86	21.3
11/30/85	14.7	01/19/86	22.7
12/01/85	14.0	01/20/86	20.7
12/02/85	15.3	01/21/86	22.7
12/03/85	20.0	01/22/86	28.7
12/04/85	16.7	01/23/86	27.3
12/05/85	9.3	01/24/86	27.3
12/06/85	11.3	01/25/86	16.7
12/07/85	11.3	01/26/86	24.0
12/08/85	12.7	01/27/86	32.7
12/09/85	11.3	01/28/86	36.0
12/10/85	14.7	01/29/86	23.3
12/11/85	18.7	01/30/86	27.3
12/12/85	13.3	01/31/86	26.7
12/13/85	10.7	02/01/86	28.7
12/14/85	12.7	02/02/86	29.3
12/15/85	12.0	02/03/86	17.3
12/16/85	12.0	02/04/86	12.0
12/17/85	21.3	02/05/86	20.0
12/18/85	22.0	02/06/86	14.7
12/19/85	18.7	02/07/86	14.0
12/20/85	20.0	02/08/86	13.3
12/21/85	14.7	02/09/86	16.0
12/22/85	12.0	02/10/86	17.3
12/23/85	13.3	02/11/86	12.7
12/24/85	14.7	02/12/86	15.3
12/25/85	10.7	02/13/86	25.3
12/26/85	12.0	02/14/86	34.7
12/27/85	18.0	02/15/86	18.7
12/28/85	13.3	02/16/86	20.0
12/29/85	14.0	02/17/86	22.0
12/30/85	20.0	02/18/86	26.7
12/31/85	18.0	02/19/86	26.0
01/01/86	10.7	02/20/86	16.7
01/02/86	12.7	02/21/86	18.7
01/03/86	17.3	02/22/86	22.0
01/04/86	16.0	02/23/86	20.0
01/05/86	16.0	02/24/86	22.0
01/06/86	19.3	02/25/86	18.0
01/07/86	22.7	02/26/86	14.7
01/08/86	25.3	02/27/86	6.7
01/09/86	14.0	02/28/86	10.7
01/10/86	20	03/01/86	14.0
01/11/86	21.3	03/02/86	14.7
01/12/86	18.7	03/03/86	17.0
01/13/86	16.7	03/04/86	20.7
01/14/86	17.3	03/05/86	25.3
01/15/86	16.0	03/06/86	25.3
01/16/86	22.0	03/07/86	24.7
01/17/86	21.3	03/08/86	14.5

DATE	TSS
03/09/86	13.0
03/10/86	17.3
03/11/86	28.0
03/12/86	22.0
03/13/86	31.3
03/14/86	14.0
03/15/86	10.7
03/16/86	8.7
03/17/86	8.7
03/18/86	8.0
03/19/86	7.3
03/20/86	8.0
03/21/86	8.0
03/22/86	2.0
03/23/86	14.7
03/24/86	11.3
03/25/86	8.0
03/26/86	8.7
03/27/86	11.3
03/28/86	7.3
03/29/86	9.3
03/30/86	10.0
03/31/86	16.0
04/01/86	12.0
04/02/86	15.3
04/03/86	10.7
04/04/86	14.0
04/05/86	14.0
04/06/86	22.7
04/07/86	47.3
04/08/86	62.0
04/09/86	62.7
04/10/86	51.3
04/11/86	36.0
04/12/86	33.3
04/13/86	34.0
04/14/86	10.0
04/15/86	14.7
04/16/86	10.0
04/17/86	14.7
04/18/86	24.7
04/19/86	25.3
04/20/86	18.0
04/21/86	28.7
04/22/86	30.7
04/23/86	38.7
04/24/86	24.7
04/25/86	33.3
04/26/86	23.3
04/27/86	28.0

DATE	TSS
04/28/86	21.3
04/29/86	14.0
04/30/86	22.7
05/01/86	21.3
05/02/86	14.0
05/03/86	21.3
05/04/86	11.3
05/05/86	12.0
05/06/86	7.3
05/07/86	11.3
05/08/86	5.3
05/09/86	12.7
05/10/86	4.0
05/11/86	9.3
05/12/86	8.7
05/13/86	12.0
05/14/86	17.3
05/15/86	16.0
05/16/86	7.3
05/17/86	9.3
05/18/86	6.0
05/19/86	10.3
05/20/86	11.0
05/21/86	12.7
05/22/86	9.3
05/23/86	3.3
05/24/86	6.0
05/25/86	3.3
05/26/86	6.0
05/27/86	7.3
05/28/86	16.0
05/29/86	13.3
05/30/86	9.3
05/31/86	15.3
06/01/86	9.3
06/02/86	12.7
06/03/86	14.0
06/04/86	9.3
06/05/86	9.3
06/06/86	9.3
06/07/86	18.7
06/08/86	12.7
06/09/86	6.0
06/10/86	0.0
06/11/86	4.0
06/12/86	1.3
06/13/86	0.0
06/14/86	4.7
06/15/86	8.0
06/16/86	5.0

DATE	TSS
06/17/86	3.3
06/18/86	9.3
06/19/86	7.3
06/20/86	3.3
06/21/86	9.3
06/22/86	10.7
06/23/86	13.3
06/24/86	9.3
06/25/86	8.0
06/26/86	6.0
06/27/86	18.7
06/28/86	8.7
06/29/86	10.0
06/30/86	16.7
07/01/86	12.7
07/02/86	13.3
07/03/86	13.3
07/04/86	17.3
07/05/86	12.0
07/06/86	10.7
07/07/86	16.7
07/08/86	34.0
07/09/86	23.3
07/10/86	36.7
07/11/86	22.7
07/12/86	13.3
07/13/86	18.0
07/14/86	17.3
07/15/86	18.0
07/16/86	12.0
07/17/86	20.0
07/18/86	14.7
07/19/86	23.3
07/20/86	10.7
07/21/86	14.0
07/22/86	12.7
07/23/86	11.3
07/24/86	9.3
07/25/86	8.7
07/26/86	17.3
07/27/86	3.3
07/28/86	7.3
07/29/86	12.0
07/30/86	8.7
07/31/86	9.3
08/01/86	8.0
08/02/86	13.3
08/03/86	10.7
08/04/86	7.3
08/05/86	3.3

DATE	TSS
08/06/86	9.3
08/07/86	5.3
08/08/86	4.0
08/09/86	12.7
08/10/86	10.0
08/11/86	6.7
08/12/86	8.0
08/13/86	2.0
08/14/86	8.7
08/15/86	19.3
08/16/86	9.3
08/17/86	6.7
08/18/86	13.3
08/19/86	18.7
08/20/86	9.3
08/21/86	14.0
08/22/86	11.3
08/23/86	4.7
08/24/86	7.3
08/25/86	8.7
08/26/86	16.7
08/27/86	8.0
08/28/86	10.7
08/29/86	28.7
08/30/86	6.0
08/31/86	10.0

APPENDIX I

Final Effluent: Daily Average Parameters (mg/L)
(Blank spaces indicate data not collected.)

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
----	----	-----	-----	----	-----	-----	---
12/16/84	24.7	0.2	10.0	0.0	22.7	0.1	7.5
12/17/84	14.3	0.4	8.3	0.0	23.6	0.0	7.3
12/18/84	26.0	0.2	9.9	0.0	23.1	0.0	7.5
12/19/84	30.7	0.5	9.3	0.0	23.8	0.0	7.5
12/20/84	31.3	0.5	5.1	0.0	27.1	0.0	7.8
12/21/84	21.3	0.5	7.2	0.0	27.2	0.0	7.6
12/22/84	21.0	0.1	15.1	0.0	25.5	0.0	7.5
12/23/84	22.0	0.1	33.9	0.0	23.5	0.8	7.3
12/24/84	16.3	0.1	17.9	0.0	22.1	0.7	7.4
12/25/84	19.0	0.1	13.6	0.0	25.3	0.5	7.0
12/26/84	14.0	0.1	14.8	0.0	20.1	0.3	7.3
12/27/84	29.7	0.1	5.0	0.0	21.8	0.1	7.4
12/28/84	14.3	0.1	6.2	0.0	20.6	0.1	7.5
12/29/84	27.7	0.1	7.1	0.0	21.8	0.1	7.4
12/30/84	15.3	0.0	3.8	0.0	22.6	0.5	7.4
12/31/84	14.0	0.9	2.7	1.3	23.5	0.3	7.3
01/01/85	13.7	0.9	1.4	0.0	21.8	0.4	7.6
01/02/85	14.7	0.1	1.3	0.0	22.1	0.2	7.3
01/03/85	15.3	0.2	3.7	0.0	19.4	0.0	7.9
01/04/85	21.3	0.2	5.3	0.0	20.6	0.0	7.3
01/05/85	8.0	0.2	3.1	0.7	17.2	0.1	7.6
01/06/85	35.0	0.1	3.9	0.0	18.4	0.1	7.2
01/07/85	11.0	0.2	1.6	0.0	16.9	0.3	7.5
01/08/85	17.0	0.1	2.8	0.0	19.7	0.3	7.3
01/09/85	18.0	0.2	3.3	0.0	17.7	19.0	7.3
01/10/85	34.7	1.3	4.7	0.0	18.0	7.3	7.4
01/11/85	33.7	0.1	5.8	0.0	17.1	5.2	7.2
01/12/85	27.0	0.1	6.7	0.0	16.4	3.5	7.4
01/13/85	27.3	0.1	4.7	0.0	16.9	1.8	7.4
01/14/85	24.7	0.1	5.3	0.0	15.7	0.7	7.4
01/15/85	24.7	0.1	2.6	0.0	17.6	0.8	7.2
01/16/85	17.3	0.1	4.0	0.0	16.1	0.2	7.2
01/17/85	15.0	0.1	2.3	0.0	15.8	0.0	7.3
01/18/85	20.3	0.1	3.2	6.7	16.1	2.4	7.2
01/19/85	37.7	0.1	2.9	0.0	17.0	0.3	7.1
01/20/85	25.0	0.1	5.5	0.0	16.4	0.3	7.1
01/21/85	25.7	0.1	3.4	0.0	11.6	0.1	7.0
01/22/85	21.0	0.1	2.6	0.0	12.7	2.3	6.9
01/23/85	22.7	0.1	2.8	0.0	17.4	5.0	7.1
01/24/85	24.3	3.1	3.7	0.0	13.6	4.7	7.2
01/25/85	36.7	0.1	4.4	0.0	17.0	2.3	7.2
01/26/85	66.7	0.1	4.1	0.0	13.7	0.4	7.3
01/27/85	19.3	0.1	3.7	2.7	15.7	1.0	7.1
01/28/85	30.3	0.1	3.2	0.7	14.9	0.4	7.3
01/29/85	28.7	0.1	5.6	0.0	20.0	0.2	7.5
01/30/85	26.0	0.2	7.0	0.0	15.0	0.2	7.2
01/31/85	37.3	0.6	5.7	0.0	19.7	0.2	7.0
02/01/85	38.0	0.2	7.3	4.7	16.3	0.2	6.9
02/02/85	41.0	0.1	6.5	5.3	17.7	0.1	7.1
02/03/85	30.0	0.2	6.8	0.0	13.9	0.1	7.3

DATE ----	COD ---	NH3N ----	NO3N ----	TSS ---	TEMP ----	PHOS -----	pH --
02/04/85	20.3	0.2	7.0	0.0	20.3	0.2	7.1
02/05/85	27.7	0.2	12.5	0.0	15.8	0.1	7.2
02/06/85	45.3		8.7	1.3	16.8	0.1	7.1
02/07/85	35.0		8.4	0.0	18.2	0.1	7.1
02/08/85	33.0		9.7	0.0	14.8	0.1	7.3
02/09/85	34.3		9.2	0.0	17.0	0.1	7.2
02/10/85	33.7		7.1	0.0	17.4	0.1	7.2
02/11/85	40.3	0.3	6.3	0.0	20.8	0.2	6.8
02/12/85	45.0	0.2	6.2	7.0	17.4	0.1	7.1
02/13/85	26.0	0.1	1.1	0.0	12.6	0.2	6.9
02/14/85	44.7		1.7	6.7	13.0	0.1	7.1
02/15/85	29.7		0.7	0.7	17.0	0.4	7.0
02/16/85	26.7	0.1	0.8	0.0	18.2	0.1	7.0
02/17/85	32.0	0.2	0.7	0.0	19.2	0.1	6.9
02/18/85	44.7	0.1	0.7	0.0	19.0	0.2	7.2
02/19/85	35.0	0.1	0.8	0.0	19.7	0.1	7.3
02/20/85	31.3	0.1	1.5	0.0	18.9	0.2	6.7
02/21/85	39.7	0.1	2.0	0.0	17.9	0.2	7.3
02/22/85	40.0	0.1	2.1	3.3	18.2	0.3	7.2
02/23/85	33.0	0.1	2.5	0.0	19.7	0.2	7.2
02/24/85	38.7	0.3	1.8	7.3	19.3	0.2	7.2
02/25/85	29.3	0.2	1.6	4.0	20.3	0.1	7.1
02/26/85	30.0	0.1	1.5	14.0	21.4	0.2	7.3
02/27/85	51.0	0.1	1.8	14.0	21.1	0.1	7.3
02/28/85	44.0	0.1	2.5	6.0	20.5	0.1	7.2
03/01/85	31.0	0.1	6.0	2.7	22.0	0.1	7.2
03/02/85	31.0	0.1	1.7	13.3	18.8	0.2	7.4
03/03/85	39.0	0.1	2.1	11.3	18.8	0.2	7.3
03/04/85	33.7	0.1	4.0	6.0	21.0	0.1	7.3
03/05/85	29.7	0.2	8.8	10.0	21.2	0.1	7.3
03/06/85	24.3	0.1	8.3	5.3	20.7	0.1	7.4
03/07/85	31.0	0.1	6.1	0.0	20.8	0.1	7.3
03/08/85	33.0	0.1	1.7	0.0	22.5	0.2	7.4
03/09/85	30.0	0.1	2.3	22.0	20.7	1.3	7.3
03/10/85	36.7	0.1	3.3	0.0	20.9	1.2	7.3
03/11/85	28.0	0.1	2.0	9.3	21.5	1.0	7.3
03/12/85	36.3	0.1	4.7	2.3	23.1	0.8	7.3
03/13/85	21.7	0.1	7.3	0.0	20.4	0.4	7.4
03/14/85	23.3	0.0	2.7	0.0	21.7	0.9	7.4
03/15/85	30.0	0.1	2.7	0.0	20.0	1.7	7.6
03/16/85	34.7	0.1	4.0	0.0	21.0	1.9	7.5
03/17/85	17.3	0.1	2.3	0.3	18.6	1.6	7.7
03/18/85	22.7	0.2	4.3	0.7	19.5	1.8	7.5
03/19/85	29.7	0.1	6.3	0.0	21.0	2.2	7.2
03/20/85	41.0	1.2	15.0	5.3	18.5	1.2	7.3
03/21/85	28.3	2.2	8.3	0.0	19.3	0.9	7.4
03/22/85	49.7	0.1	1.6	0.0	19.8	0.7	7.2
03/23/85	28.3	0.2	6.0	0.0	20.2	0.8	7.5
03/24/85	36.4	0.2	8.3	2.7	20.2	1.9	7.5
03/25/85	29.7	0.3	9.7	0.0	19.3	1.3	7.3

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
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03/26/85	35.7	0.1	6.7	2.0	22.0	0.2	7.4
03/27/85	34.0	0.1	5.7	0.0	21.5	1.4	7.3
03/28/85	24.0	0.1	4.4	0.0	21.3	0.8	7.2
03/29/85	34.0	0.1	12.7	0.0	21.7	1.1	7.2
03/30/85	18.7	0.1	8.7	0.0	23.9	0.9	7.2
03/31/85	14.3	0.1	9.0	0.0	23.1	1.1	7.6
04/01/85	17.3	0.1	4.0	0.0	21.6	1.3	7.6
04/02/85	17.7	0.1	8.3	0.0	20.6	0.3	7.4
04/03/85	19.0	0.0	9.7	1.3	21.4	0.2	7.4
04/04/85	28.3	0.1	11.7	0.0	22.5	0.2	7.5
05/04/85	22.0	0.3	31.3	0.0	23.5	0.2	7.3
04/06/85	23.3	0.1	5.0	0.0	21.9	0.2	7.2
04/07/85	23.0	0.1	7.0	0.0	21.1	0.1	7.3
04/08/85	34.0	0.1	9.7	0.0	20.4	0.1	7.4
04/09/85	26.7	0.1	9.3	0.0	19.4	0.1	7.5
04/10/85	31.3	0.1	9.5	0.0	19.1	0.0	7.3
04/11/85	23.7	0.0	8.7	0.0	21.0	0.1	7.5
04/12/85	28.0	0.0	3.7	0.0	23.0	0.1	7.3
04/13/85	28.0	0.1	9.5	0.0	22.6	0.3	7.4
04/14/85	20.3	0.1	7.7	0.0	23.9	0.1	7.4
04/15/85	20.3	0.1	4.1	0.0	23.4	0.2	7.3
04/16/85	20.3	0.1	13.7	0.0	23.6	0.1	7.3
04/17/85	8.3	0.3	9.3	0.0	23.2	0.1	7.3
04/18/85	15.7	0.1	11.1	0.0	24.1	0.1	7.4
04/19/85	44.3	0.2	14.2	0.0	23.1	0.1	7.4
04/20/85	21.3	0.1	14.6	0.0	26.0	0.1	7.5
04/21/85	27.0	0.1	8.4	0.0	25.5	0.1	7.4
04/22/85	25.0	0.1	7.0	0.0	24.6	0.1	7.7
04/23/85	14.3	0.1	13.0	0.0	24.5	0.1	7.2
04/24/85	20.3	0.1	26.6	0.0	25.0	0.4	7.3
04/25/85	17.0	0.1	26.3	0.0	24.3	0.5	7.4
04/26/85	7.3	0.1	12.6	4.0	24.4	0.5	7.3
04/27/85	23.3	0.1	21.4	0.0	24.4	0.4	7.6
04/28/85	14.0	0.1	13.7	0.0	25.2	0.4	7.3
04/29/85	18.0	0.1	20.3	0.0	25.0	1.0	7.6
04/30/85	11.7	0.1	21.5	0.0	27.2	0.5	7.3
05/01/85	18.0	0.1	14.9	0.0	23.7	1.8	7.3
05/02/85	23.3	0.0	12.7	0.0	24.9	1.5	7.4
05/03/85	30.3	0.0	27.2	0.0	22.8	3.3	7.5
05/04/85	27	0.77	37	0.0	22.4	3.4	7.6
05/05/85	17.0	0.3	22.7	0.0	22.7	2.5	7.4
05/06/85	31.3	0.4	19.0	0.0	22.7	1.7	7.1
05/07/85	27.3	0.1	27.7	0.0	23.0	1.0	7.2
05/08/85	17.0	0.1	35.7	0.0	23.5	0.7	7.7
05/09/85	18.0	0.1	36.2	0.0	22.4	0.5	7.5
05/10/85	14.7	0.1	32.4	0.0	22.2	0.6	7.3
05/11/85	20.0	0.1	27.3	0.0	23.7	0.7	7.6
05/12/85	24.0	0.1	24.7	0.0	23.7	0.5	7.4
05/13/85	22.0	1.5	24.5	0.0	24.0	0.4	7.2
05/14/85	24.3	0.1	18.7	0.0	24.0	0.6	7.3

DATE ----	COD ---	NH3N -----	NO3N -----	TSS ---	TEMP -----	PHOS -----	pH --
05/15/85	23.3	0.3	19.0	6.7	24.5	0.7	7.3
05/16/85	40.3	0.5	20.6	20.0	22.9	0.9	7.4
05/17/85	36.3	0.3	27.4	5.3	23.3	0.7	7.4
05/18/85	36.3	0.2	22.7	8.7	22.3	0.5	7.5
05/19/85	29.7	0.3	9.3	13.3	21.3	0.4	7.9
05/20/85	36.7	0.2	10.7	16.7	23.5	0.8	7.3
05/21/85	34.0	0.3	22.5	10.7	24.2	0.6	7.3
05/22/85	43.0	0.2	24.3	12.0	24.0	0.4	7.3
05/23/85	30.3	0.2	28.0	2.7	24.6	0.7	7.3
05/24/85	30.0	0.2	33.7	7.3	23.7	0.2	7.3
05/25/85	33.7	0.3	12.1	5.3	23.1	0.3	7.2
05/26/85	31.7	0.2	29.0	4.7	23.2	0.2	7.5
05/27/85	25.3	0.2	19.0	4.0	24.6	0.1	7.4
05/28/85	35.7	0.4	24.8	9.3	23.5	0.2	7.5
05/29/85	31.7	0.3	28.4	7.3	24.3	0.1	7.7
05/30/85	36.3	0.3	10.5	8.0	24.5	0.5	7.6
05/31/85	35.3	0.3	11.5	8.0	26.3	0.4	7.9
06/01/85	34.0	0.5	12.7	4.0	25.7	0.5	7.9
06/02/85	38.7	0.4	16.3	6.7	24.9	0.3	7.6
06/03/85	33.3	0.6	16.3	9.3	25.6	0.2	7.2
06/04/85	50.0	0.3	15.7	12.0	25.9	0.2	7.1
06/05/85	27.7	0.3	15.1	4.7	25.5	1.0	7.2
06/06/85	38.7	0.2	20.5	6.0	25.9	0.8	7.4
06/07/85			15.7	4.7	26.6	1.0	7.4
06/08/85			3.1	4.0	26.1	0.7	7.3
06/09/85	32.0		1.3	4.0	27.0	1.0	7.1
06/10/85	37.7	0.2	2.8	2.7	27.5	1.6	7.2
06/11/85	18.7	0.2	5.7	7.3	27.5	1.2	6.9
06/12/85	30.0	0.5	7.3	0.0	28.4	0.9	6.9
06/13/85	23.0	0.1	4.9	0.0	26.4	0.7	7.1
06/14/85	16.0	0.2	4.9	0.0	25.0	0.7	7.3
06/15/85	25.0	0.1	5.6	0.7	25.2	0.6	7.2
06/16/85	36.7	0.1	0.9	0.7	26.7	0.6	7.1
06/17/85	14.3	0.7	2.2	2.7	28.4	2.4	6.7
06/18/85	25.7	1.8	6.8	2.0	27.1	2.4	6.9
06/19/85	36.0	4.6	15.4	1.3	24.6	3.2	7.1
06/20/85	33.7	0.2	2.0	5.3	25.6	3.0	7.0
06/21/85	30.3	0.2	5.0	2.0	24.8	1.3	7.4
06/22/85	24.8	0.1	3.8	8.7	26.8	2.1	7.0
06/23/85	18.5	0.3	3.7	4.7	28.5	0.8	6.8
06/24/85	16.0	0.1	4.6	4.7	27.0	0.8	7.4
06/25/85	26.3	0.2	8.3	0.7	25.5	0.7	7.7
06/26/85	7.0	0.2	13.0	0.0	24.9	0.3	7.6
06/27/85	22.7	0.2	5.2	0.7	25.4	0.4	7.6
06/28/85	19.7	0.1	5.4	4.0	24.8	0.2	7.6
06/29/85	22.7	0.1	5.3	0.0	25.2	0.2	7.7
06/30/85	31.0	0.1	9.7	3.3	24.1	0.6	7.8
07/01/85	30.7	0.2	9.3	0.7	25.0	1.0	7.6
07/02/85	12.0	0.2	5.0	0.0	25.2	1.6	7.3
07/03/85	26.7	0.2	7.4	5.3	24.3	2.3	7.5

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
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07/04/85	27.0	0.2	13.8	0.0	24.5	2.4	7.5
07/05/85	26.0	0.2	3.2	0.0	25.4	2.5	7.7
07/06/85	20.5	0.1	3.0	0.0	25.2	2.5	7.5
07/07/85	15.7	0.1	1.6	0.7	24.1	1.3	7.7
07/08/85	29.0	0.1	2.4	0.0	24.7	0.8	7.6
07/09/85	20.7	0.1	1.8	0.0	24.1	1.1	7.7
07/10/85	14.3	0.1	2.3	0.0	25.6	0.8	7.7
07/11/85	24.3	1.5	17.8	0.0	25.0	1.1	8.0
07/12/85	35.0	1.3	11.8	1.3	25.6	2.3	7.9
07/13/85	26.3	0.3	13.9	0.0	24.7	2.6	7.8
07/14/85	17.7	0.1	13.1	0.0	24.1	3.7	7.8
07/15/85	24.3	0.2	4.1	0.0	26.0	1.6	7.7
07/16/85	30.3	0.2	8.2	2.0	24.7	1.5	7.8
07/17/85	25.0	0.2	16.9	2.7	24.3	0.8	7.7
07/18/85	19.0	0.2	15.0	0.0	25.7	0.7	7.6
07/19/85	21.3	1.3	18.0	4.7	25.4	0.5	7.6
07/20/85	22.7	3.9	16.0	2.7	24.0	0.5	7.5
07/21/85	20.7	0.3	12.0	4.0	24.4	0.9	7.6
07/22/85	16.0	0.7	11.7	2.7	24.1	0.6	7.8
07/23/85	14.7	0.2	6.0	5.3	24.1	0.5	7.7
07/24/85	13.0	0.1	8.6	1.3	23.6	0.5	7.8
07/25/85	21.7	0.1	7.1	0.7	23.0	0.3	7.8
07/26/85	17.0	0.2	20.9	0.0	23.8	0.6	8.1
07/27/85	14.7	0.1	11.0	4.0	25.0	0.7	7.8
07/28/85	17.7	0.2	14.7	0.0	24.1	0.9	7.7
07/29/85	18.3	0.2	14.7	5.0	24.7	0.6	7.9
07/30/85	14.0	0.2	18.0	7.3	24.4		7.9
07/31/85	14.7	0.1	17.0	4.0	24.9		7.6
08/01/85	17.3	0.1	15.7	4.0	24.5		7.7
08/02/85	21.0	0.1	7.7	0.0	24.7		7.8
08/03/85	20.7	0.2	10.3	2.7	25.5		7.2
08/04/85	18.0	0.1	9.7	0.7	24.4		7.6
08/05/85	19.0	0.1	15.1	0.0	23.8		7.2
08/06/85	23.0	0.1	18.4	0.0	23.7		7.6
08/07/85	14.7	0.1	14.3	0.0	24.6		7.5
08/08/85	39.0	0.1	5.8	0.0	24.2		7.7
08/09/85	13.7	0.1	10.1	0.0	25.2		7.5
08/10/85	25.7	0.1	10.0	3.3	24.5		7.3
08/11/85	19.3	0.1	12.1	0.0	25.1		7.6
08/12/85	23.3	0.1	14.6	1.3	25.8		7.7
08/13/85	22.3	0.1	13.4	0.0	26.2		7.2
08/14/85	20.7	0.2	11.2	7.3	26.2		7.6
08/15/85	20.0	0.2	17.0	7.3	25.8		7.5
08/16/85	22.0	0.2	15.7	6.0	24.7		7.5
08/17/85	12.3	0.2	12.3	0.7	25.3		7.6
08/18/85	21.0	0.1	16.3	2.0	24.3		7.5
08/19/85	19.0	0.1	16.7	2.7	25.2		7.3
08/20/85	18.7	0.1	18.0	1.3	25.2		7.7
08/21/85	22.3	0.1	15.0	0.7	25.1		7.6
08/22/85	19.7	0.1	11.0	0.0	26.8		7.9

DATE ----	COD ---	NH3N -----	NO3N -----	TSS ---	TEMP -----	PHOS -----	pH --
08/23/85	23.3	0.1	13.3	0.7	26.6		7.8
08/24/85	18.0	0.1	14.3	0.0	25.6		7.6
08/25/85	26.7	0.1	13.7	0.7	24.9		7.7
08/26/85	15.0	0.2	15.3	0.0	26.8		7.5
08/27/85	16.3	0.1	14.0	1.3	27.9		7.7
08/28/85	13.3	0.1	10.0	1.3	25.8		7.7
08/29/85	15.7	0.4	9.6	0.0	24.8		7.8
08/30/85	19.7	0.1	10.5	0.0	23.7		7.8
08/31/85	18.3	0.1	10.4	0.0	25.2		7.7
09/01/85	15.0	0.1	11.2	0.0	25.1		7.7
09/02/85	15.7	0.2	10.2	0.0	24.6		7.6
09/03/85	24.0	0.1	8.2	0.0	24.6		7.6
09/04/85	26.3	0.1	10.0	0.0	24.8		7.7
09/05/85	29.0	0.2	9.7	0.0	25.4		7.6
09/06/85	26.0	0.4	10.6	0.0	24.9		7.6
09/07/85	24.0	0.3	9.7	0.0	24.4		7.5
09/08/85	19.0	0.2	9.9	0.0	26.0		7.5
09/09/85	46.0	0.2	13.0	0.0	25.7		7.5
09/10/85	23.7	0.2	13.0	0.0	25.9		7.4
09/11/85	21.7	0.2	14.1	6.7	24.7		7.6
09/12/85	21.0	0.2	14.3	8.7	24.9		7.6
09/13/85	23.0	0.1	19.7	1.0	23.7		7.8
09/14/85	32.7	0.1	17.7	0.0	22.0		7.9
09/15/85	36.3	0.1	16.9	5.0	22.1		7.3
09/16/85	36.0	0.1	15.0	2.0	23.6		7.8
09/17/85	36.3	0.3	13.0	8.0	23.3		7.8
09/18/85	32.3	0.3	17.7	1.3	23.6		7.8
09/19/85	31.7	0.2	23.4	0.0	23.2		7.7
09/20/85	38.7	0.2	17.8	0.7	23.2		7.8
09/21/85	31.0	0.2	20.3	0.0	23.7		7.7
09/22/85	23.0	0.2	17.7	0.0	22.9		7.8
09/23/85	25.7	0.1	15.3	0.0	23.4		7.7
09/24/85	28.0	0.1	13.3	0.0	25.1		7.7
09/25/85	30.3	0.2	15.0	0.0	23.6		7.8
09/26/85	28.7	0.2	18.0	1.3	23.3		7.7
09/27/85	18.7	0.2	15.9	0.0	22.4		7.7
09/28/85	29.7	0.2	16.3	0.0	22.4		7.8
09/29/85	28.3	0.2	19.2	0.0	21.8		7.7
09/30/85	29.0	0.2	18.9	0.0	22.7		7.7
10/01/85	30.0	0.2	19.1	0.0	23.6		7.7
10/02/85	34.3	0.2	22.7	0.0	22.9		7.8
10/03/85	31.7	0.2	22.2	4.7	23.4		7.7
10/04/85	28.3	0.1	20.4	0.0	23.7		7.6
10/05/85	21.0	0.2	19.9	0.0	22.7		7.7
10/06/85	32.0	0.2	22.3	0.0	20.8		7.7
10/07/85	28.3	0.1	26.0	0.0	20.3		8.0
10/08/85	20.3	0.2	25.3	0.0	21.4		8.0
10/09/85	24.0	0.2	26.5	0.0	22.5		8.0
10/10/85	29.0	0.1	20.3	0.7	22.9		8.0
10/11/85	20.3	0.2	19.7	1.3	23.4		8.0

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
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10/12/85	25.0	0.1	25.8	1.3	23.2		8.2
10/13/85	22.3	0.2	19.9	4.7	23.7		8.2
10/14/85	33.8	3.3		1.3	23.6		8.2
10/15/85	16.7	0.3		3.3	24.0		8.1
10/16/85	25.3	2.7		1.3	24.1		8.1
10/17/85	23.7	0.2		0.0	23.8		8.1
10/18/85	25.7	0.9		0.7	23.6		7.9
10/19/85	34.3	0.1		0.0	23.7		7.8
10/20/85	21.7	0.1		0.0	23.8		7.8
10/21/85	24.3	0.2	5.0	0.0	24.2		7.7
10/22/85	27.0	0.3	11.0	0.0	22.4		7.4
10/23/85	18.7	0.2		0.0	23.0		7.6
10/24/85	17.7	0.1	5.9	0.0	22.9		7.7
10/25/85	21.3	0.2	16.3	0.0	23.6		7.8
10/26/85	17.3	0.2	5.8	0.0	22.8		7.8
10/27/85	20.0	0.2	6.8	0.0	21.3		7.8
10/28/85	22.0	0.2	4.4	0.0	23.2		7.8
10/29/85	26.3	0.2	3.3	0.0	21.3		7.9
10/30/85	31.0	0.2	8.0	1.3	21.6		7.9
10/31/85	17.0	0.1	10.5	0.0	22.2		7.9
11/01/85	22.0	0.2	14.0	0.0	23.0		7.9
11/02/85	23.3	0.3	11.3	0.7	22.6		8.0
11/03/85	18.4	0.2	9.2	0.0	22.3		8.0
11/04/85	30.0	0.2	11.2	2.0	20.9		7.9
11/05/85	25.7	0.2	12.1	2.0	19.0		8.0
11/06/85	32.0	0.2	15.9	0.0	19.7		7.9
11/07/85	33.7	0.2	12.7	1.3	19.3		8.0
11/08/85	27.3	0.2		0.7	19.0		8.0
11/09/85	30.7	0.2	5.7	0.0	19.1		8.0
11/10/85	23.7	0.1	2.0	0.0	20.1		7.9
11/11/85	22.0	0.5	3.0	0.0	22.1		8.0
11/12/85	23.3	0.1	5.7	0.0	21.8		8.0
11/13/85	27.7	0.3	7.3	0.0	20.8		7.9
11/14/85	29.0	0.2	5.0	0.0	22.8		7.9
11/15/85	22.3	0.2	5.0	0.0	21.8		8.0
11/16/85	19.7	0.2	4.3	0.0	22.6		8.0
11/17/85	21.7	0.2	4.3	0.0	22.3		7.9
11/18/85	19.7	0.2	3.0	0.0	22.4		8.0
11/19/85	38.3	0.2	1.0	0.0	23.0		7.9
11/20/85	30.3	0.3	1.3	0.0	22.8		7.8
11/21/85	36.7	0.3	1.3	0.0	21.5		7.8
11/22/85	27.3	0.3	3.7	0.0	20.8		7.8
11/23/85	27.0	0.2	5.7	0.0	19.2		7.9
11/24/85	23.0	0.2	5.0	0.0	19.9		7.9
11/25/85	27.0	0.3	5.0	0.0	20.3		7.8
11/26/85	35.3	0.3	5.7	0.0	21.0		7.8
11/27/85	19.0	0.3	6.7	1.3	22.2		7.9
11/28/85	28.0	0.4	7.0	0.7	21.8		7.8
11/29/85	34.0	0.3	6.0	0.0	21.5		7.7
11/30/85	32.7	0.2	5.0	0.0	20.5		7.8

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
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12/01/85	30.7	0.2	5.0	1.3	20.3		7.8
12/02/85	31.0	0.3	3.7	2.7	18.6		7.8
12/03/85	30.3	0.2	5.3	2.0	16.7		7.9
12/04/85	29.7	0.2	5.0	0.0	18.4		8.0
12/05/85	25.7	0.3	4.3	0.0	18.9		7.8
12/06/85	30.0	0.2	4.3	0.0	18.4		7.9
12/07/85	27.0	0.2	3.3	0.0	19.0		7.8
12/08/85	32.7	0.2	1.3	0.7	19.1		7.8
12/09/85	28.3	0.2	2.0	0.0	20.1		7.7
12/10/85	33.0	0.4	6.7	0.0	20.4		7.8
12/11/85	22.7	0.3	5.3	0.0	17.8		7.8
12/12/85	28.7	0.3	4.3	0.0	20.4		7.9
12/13/85	34.0	0.3	3.0	0.0	19.7		7.9
12/14/85	45.7	0.3	3.0	0.0	18.0		7.9
12/15/85	33.7	0.4	3.3	0.0	18.0		7.9
12/16/85	76.0	0.3	3.7	0.0	15.9		7.9
12/17/85	53.7	0.3	1.0	1.3	17.3		7.9
12/18/85	41.7	0.2	1.0	2.7	15.6		7.7
12/19/85	48.0	0.2	1.3	7.3	14.3		7.5
12/20/85	57.3	0.3	1.0	0.0	14.2		8.0
12/21/85	66.0	0.2	1.0	0.0	12.6		8.1
12/22/85	48.7	0.9	1.0	0.0	13.0		8.0
12/23/85	49.0	0.3	1.0	0.0	15.0		8.1
12/24/85	53.7	0.3	1.0	0.0	14.5		7.5
12/25/85	47.7	0.2	1.0	0.0	12.5		7.6
12/26/85	39.3	0.0	1.0	0.0	11.7		7.6
12/27/85	28.7	0.0	2.7	1.0	12.6		7.7
12/28/85	28.3	0.0	2.3	0.0	13.1		7.7
12/29/85	25.7	0.0	1.7	1.0	13.0		7.7
12/30/85	25.3	0.1	1.3	0.0	12.8		7.8
12/31/85	27.7	0.1	1.0	0.0	13.7		7.8
01/01/86	30.7	0.1	1.0	0.0	13.8		7.4
01/02/86	36.0	0.1	1.0	0.0	13.5		7.6
01/03/86	39.3	0.0	1.0	1.3	14.1		7.7
01/04/86	33.7	0.0	1.0	0.0	14.6		7.7
01/05/86	39.0	0.0	1.0	0.0	15.0		7.6
01/06/86	40.3	0.0	1.0	4.7	12.8		7.6
01/07/86	51.3	0.0	1.0	6.0	13.1		7.5
01/08/86	41.7	0.1	1.0	6.7	12.8		7.7
01/09/86	47.3	0.0	1.0	6.0	12.4		7.5
01/10/86	31.3	0.1	1.0	3.0	12.8		7.5
01/11/86	54.7	0.5	1.7	8.0	13.7		7.6
01/12/86	49.0	0.1	1.7	2.0	13.4		7.6
01/13/86	39.7	0.1	1.0	3.0	13.2		7.6
01/14/86	52.3	0.1	1.0	4.0	13.3		7.6
01/15/86	60.7	0.1	1.7	5.0	13.3		7.3
01/16/86	88.7	0.1	2.7	14.0	13.7		7.5
01/17/86	73.3	0.0	14.0	11.0	13.7		7.6
01/18/86	85.3	0.5	6.3	7.0	14.5		7.4
01/19/86	74.3	0.7	4.0	7.0	16.8		7.5

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
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01/20/86	55.7	0.5	3.0	3	15.0		7.5
01/21/86	51.3	0.5	3.3	7	13.7		7.5
01/22/86	76.7	1.4	6.0	17	14.5		7.6
01/23/86	66.3	0.2	6.0	9	14.5		7.5
01/24/86	67.0	0.2	2.7	15	14.3		7.5
01/25/86	67.3	0.2	3.3	1	13.9		7.5
01/26/86	57.3	0.1	1.3	11	13.9		7.4
01/27/86	59.0	0.5	1.7	18	12.3		7.5
01/28/86	53.0	1.4	2.0	17	10.5		7.5
01/29/86	59.3	1.1	2.3	3	11.0		7.3
01/30/86	57.0	0.4	2.7	4	11.8		7.4
01/31/86	55.7	0.9	2.3	7	12.7		7.3
02/01/86	57.3	0.5	4.0	6	14.3		7.4
02/02/86	58.0	0.4	3.0	7	15.4		7.4
02/03/86	52.7	0.5	4.3	4	15.7		7.3
02/04/86	52.0	1.3	4.0	0	16.6		7.3
02/05/86	46.0	0.8	4.7	1	16.8		7.3
02/06/86	50.7	0.4	1.7	0	17.1		7.5
02/07/86	52.7	0.1	1.3	0	16.2		7.5
02/08/86	54.3	0.1	2.0	0	16.0		7.4
02/09/86	54.3	0.1	2.0	0	11.8		7.4
02/10/86	54.3	0.0	1.7	3	15.4		7.3
02/11/86	38.3	0.1	3.5	0	14.8		7.3
02/12/86	41.7	0.1	5.3	3	12.9		7.5
02/13/86	43.3	0.1	4.7	7	12.1		7.3
02/14/86	46.7	0.3	4.3	11	11.5		7.4
02/15/86	40.7	0.2	3.0	4	11.4		7.2
02/16/86	53.0	0.3	3.0	4	13.1		7.4
02/17/86	44.0	0.1	3.0	2	14.0		7.3
02/18/86	46.7	0.1	3.0	8	14.2		7.3
02/19/86	38.3	0.1	3.0	0	15.4		7.4
02/20/86	41.0	0.1	5.3	3	16.2		7.5
02/21/86	49.7	0.1	3.7	5	14.4		7.5
02/22/86	38.7	0.1	2.0	3	15.1		7.4
02/23/86	40.7	0.1	2.0	3	14.6		7.6
02/24/86	54.7	0.1	1.7	1	14.2		7.5
02/25/86	45.3	0.1	1.0	1	16.4		7.4
02/26/86	53.7	0.1	1.7	0	13.9		7.5
02/27/86	56.3	0.1	2.0	1	14.5		7.5
02/28/86	40.0	0.0	1.3		13.6		7.8
03/01/86	56.7	0.1	1.0	0	13.7		7.7
03/02/86	51.7	0.0	1.0	0	14.0		7.6
03/03/86	93.7	0.1	1.0	3	13.9		7.5
03/04/86	52.7	0.1	1.0	11	14.6		7.5
03/05/86	49.7	0.1	2.0	5	13.8		7.5
03/06/86	57.7	0.1	1.7	6	14.0		7.7
03/07/86	54.0	0.1	1.3	5	14.1		7.6
03/08/86	49.7	0.1	1.0	4	13.1		7.6
03/09/86	42.0	0.1	1.0	2	15.0		7.5
03/10/86	35.3	0.3	2.3	5	18.5		7.5

DATE	COD	NH3N	NO3N	TSS	TEMP	PHOS	pH
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03/11/86	42.3	0.1	2.3	5	18.6		7.6
03/12/86	37.7	0.1	2.3	3	17.8		7.5
03/13/86	41.0	0.2	2.0	11	19.4		7.6
03/14/86	28.7	0.1	1.7	5	18.9		7.6
03/15/86	47.0	0.2	2.0	0	17.9		7.5
03/16/86	41.0	0.2	1.7	1	18.0		7.5
03/17/86	41.0	0.1	1.7	1	18.2		7.5
03/18/86	23.8	0.1	2.0	1	18.4		7.6
03/19/86	24.3	0.2	1.7	2	19.4		7.6
03/20/86	31.3	0.1	2.7	3	14.9		7.5
03/21/86	44.0	0.2	1.7	1	14.8		7.7
03/22/86	26.0	0.0	2.7	0	15.2		7.8
03/23/86	26.0	0.0	2.3	0	16.2		7.6
03/24/86	27.7	0.1	1.5	1	17.8		7.6
03/25/86	29.0	0.1	2.3	1	18.7		7.6
03/26/86	31.7	0.1	2.0	5	18.2		7.4
03/27/86	35.3	0.1	1.3	5	19.0		7.5
03/28/86	52.3	0.1	1.7	2	18.3		7.5
03/29/86	40.0	0.1	1.7	3	18.2		7.4
03/30/86	37.7	0.1	2.0	0	17.2		7.5
03/31/86	35.0	0.1	2.7	2	20.8		7.4
04/01/86	33.7	0.2	11.2	2	21.1		7.7
04/02/86	36.0	0.1	11.3	2	21.9		7.7
04/03/86	28.0	0.1	7.0	0	21.6		7.7
04/04/86	47.0	0.1	6.3	2	22.4		7.6
04/05/86	28.3	0.2	4.7	1	22.6		7.7
04/06/86	42.0	0.6	7.0	7	21.9		7.7
04/07/86	47.0	2.6	6.7	15	22.0		7.7
04/08/86	65.0	2.3	7.7	27	21.7		7.6
04/09/86	62.7	0.6	5.3	13	19.8		7.5
04/10/86	48.7	0.1	2.3	13	18.8		7.6
04/11/86	47.0	0.0	1.3	5	19.0		7.2
04/12/86	41.0	0.2	1.3	14	19.3		7.6
04/13/86	38.3	0.1	1.0	14	20.7		7.6
04/14/86	27.7	0.1	0.7	0	20.3		7.6
04/15/86	25.3	0.1	1.3	5	21.4		7.5
04/16/86	25.0	0.1	1.3	0	20.3		7.5
04/17/86	21.3	0.0	1.0	0	18.5		7.6
04/18/86	27.0	0.1	4.0	1	19.0		7.6
04/19/86	26.7	0.1	7.0	3	20.8		7.7
04/20/86	43.3	0.1	7.0	0	21.3		7.6
04/21/86	34.7	0.4	6.7	1	21.1		7.6
04/22/86	26.3	0.1	9.7	5	19.9		7.7
04/23/86	25.3	0.1	8.3	3	19.7		7.7
04/24/86	21.3	0.1	8.7	0	19.0		7.8
04/25/86	19.7	0.1	9.3	2	20.0		8.0
04/26/86	28.0	0.0	7.3	2	21.7		7.7
04/27/86	23.0	0.0	9.3	0	22.6		7.7
04/28/86	20.0	0.0	7.7	0	22.8		7.7
04/29/86	15.0	0.0	5.7	0	22.2		7.7

DATE	COD	NH3N	NO3N	TEMP	PHOS	pH	TSS
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04/30/86	19.0	0.2	9.7	21.3		7.8	1
05/01/86	24.3	0.1	8.0	21.8		7.6	3
05/02/86	24.3	0.5	7.3	20.4		7.8	0
05/03/86	27.7	0.1	5.7	19.2		7.9	3
05/04/86	23.3	0.1	3.3	20.1		7.9	1
05/05/86	20.7	0.1	3.7	20.9		7.7	1
05/06/86	14.3	0.1	9.3	22.4		7.8	1
05/07/86	19.0	0.1	9.3	23.1		7.7	5
05/08/86	34.0	0.1	10.0	24.0		7.7	5
05/09/86	34.7	0.1	9.3	23.3		7.8	1
05/10/86	24.7	1.2	7.3	19.6		7.8	0
05/11/86	49.7	0.1	10.7	23.5		7.8	0
05/12/86	29.0	0.2	12.0	22.9		7.7	0.
05/13/86	29.7	0.1	9.7	24.3		7.6	0
05/14/86	35.7	0.1	6.7	17.5		6.2	1
05/15/86	29.7	0.1	12.0	22.5		6.3	2
05/16/86	21.7	0.1	8.3	22.8		6.5	1
05/17/86	25.7	0.1	10.3	22.9		6.1	0
05/18/86	29.0	0.1	13.5	23.7		6.1	0
05/19/86	28.0	0.1	10.0	23		6.4	2
05/20/86	23.3	0.1	9.7	23		6.4	1
05/21/86	22.7	1.8	7.3	21.0		6.4	2
05/22/86	27.0	0.1	5.0				1
05/23/86	21		3				0
05/24/86	33		0.5				0
05/25/86	20		2				0
05/26/86	21		2				0
05/27/86	19		2				0
05/28/86	25		3				0
05/29/86	30		6				5
05/30/86	31.7		5.0				2
05/31/86	23.3		8.3				3
06/01/86	18.7		6.7				3
06/02/86	23.0		6.7				5
06/03/86	24.3		5.7				2
06/04/86	25.7		7.7				0
06/05/86	25.3		7.3				0
06/06/86	24.7		11.7				0
06/07/86	29.0		13.7				2
06/08/86	31.3		8.7				2
06/09/86	43.0		8.3				0
06/10/86	20.3		7.3				0
06/11/86	28.3		7.3				2
06/12/86	36.0		9.7				0
06/13/86	31.3		5.7				0
06/14/86	23.0		4.3				1
06/15/86	29.7		3.7				0
06/16/86	21.0		3.3				0
06/17/86	108.7		3.7				0

DATE	COD	N03N	TSS	DATE	COD	N03N	TSS
06/18/86	36.0	2.7	3	08/07/86	36.7	2.0	0
06/19/86	33.3	3.7	3	08/08/86	24.3	3.3	1
06/20/86	30.3	4.0	3	08/09/86	21.7	4.3	1
06/21/86	25.3	4.3	5	08/10/86	23.0	4.0	0
06/22/86	14.7	4.3	6	08/11/86	21.7	4.0	0
06/23/86	15.7	5.0	5	08/12/86	19.0	3.7	0
06/24/86	32.3	6.0	5	08/13/86	25.7	3.7	0
06/25/86	26.7	5.3	1	08/14/86	25.7	2.7	2
06/26/86	27.0	4.7	1	08/15/86	27.7	2.7	3
06/27/86	20.0	4.7	3	08/16/86	21.7	2.7	0
06/28/86	15.7	3.3	3	08/17/86	35.3	4.3	2
06/29/86	26.3	4.3	0	08/18/86	19.3	5.0	4
06/30/86	22.3	5.3	3	08/19/86	19.3	4.7	5
07/01/86	23.3	4.3	1	08/20/86	39.0	4.7	1
07/02/86	21.3	4.3	7	08/21/86	19.0	4.0	6
07/03/86	21.7	4.7	7	08/22/86	16.3		2
07/04/86	27.7	3.7	11	08/23/86	24.3		1
07/05/86	26.7	3.3	7	08/24/86	22.7		3
07/06/86	23.7	4.7	0	08/25/86	20.3	3.5	0
07/07/86	29.3	4.7	1	08/26/86	21.0	2.7	4
07/08/86	19.7	4.3	11	08/27/86	23.3	3.0	0
07/09/86	32.7	3.7	5	08/28/86	13.2	4.7	0
07/10/86	29.7	3.3	3	08/29/86	24.0	5.7	3
07/11/86	35.0	4.3	5	08/30/86	9.0	5.7	0
07/12/86	25.7	6.7	1	08/31/86	27.3	5.3	0
07/13/86	29.0	5.3	1				
07/14/86	20.3	5.0	4				
07/15/86	19.0	4.7	2				
07/16/86	22.3	5.0	1				
07/17/86	22.7	4.7	6				
07/18/86	37.7	4.3	3				
07/19/86	33.0	5.0	10				
07/20/86	30.0	4.0	0				
07/21/86	27.3	3.0	3				
07/22/86	27.0	3.3	7				
07/23/86	34.7	3.7	0				
07/24/86	23.0	3.7	2				
07/25/86	20.0	5.7	0				
07/26/86	27.0	5.7	8				
07/27/86	28.0	6.3	0				
07/28/86	21.0	5.0	0				
07/29/86	17.0	4.3	1				
07/30/86	19.3	4.0	0				
07/31/86	21.0	3.3	2				
08/01/86	15.0	3.0	1				
08/02/86	18.0	3.3	3				
08/03/86	16.3	1.0	3				
08/04/86	22.3	1.0	0				
08/05/86	18.7	2.3	0				
08/06/86	16.7	1.3	0				

APPENDIX J
MISCELLANEOUS DATA COLLECTED BY USABRDL^a

Date	Neutralization basin		Aeration basin 5
	Temp., °C	D.O., mg/L	Temp., °C
5 JUN 85	27.4	4.0	
6 JUN 85	27.6	3.7	
7 JUN 85	25.0	3.0	
11 JUN 85	26.1	3.9	
12 JUN 85	23.6	3.7	
13 JUN 85	19.5	3.9	
14 JUN 85	24.0	4.2	
17 JUN 85	27.0	2.1	
18 JUN 85	26.2	0.2	
19 JUN 85	26.4	0.5	
25 JUN 85	25.7	0.7	
26 JUN 85	27.6	1.6	
27 JUN 85	25.0	2.0	
2 JUL 85	24.6	2.4	
3 JUL 85	25.0	1.3	
8 JUL 85	25.1	2.2	
9 JUL 85	27.0	2.3	
16 JUL 85	26.5	1.1	
17 JUL 85	26.0	1.2	
18 JUL 85	26.2	1.4	
22 JUL 85	25.6	1.6	
23 JUL 85	25.6	2.2	
24 JUL 85	25.4	1.2	
31 JUL 85	27.0	2.5	
2 AUG 85	24.0	2.1	
5 AUG 85	25.0	2.2	
6 AUG 85	23.5	4.1	
7 AUG 85	23.5	4.1	
8 AUG 85	23.6	4.0	
9 AUG 85	25.2	3.4	
12 AUG 85	26.0	3.9	
13 AUG 85	25.4	3.8	
14 AUG 85	25.7	3.0	
15 AUG 85	28.3	3.3	
20 AUG 85	25.5	3.1	
21 AUG 85	24.0	3.5	
22 AUG 85	23.4	4.9	
23 AUG 85	20.1	4.1	
26 AUG 85	24.0	5.4	
27 AUG 85	23.7	5.1	
28 AUG 85	24.0	4.9	
4 SEP 85	25.9	0.9	
5 SEP 85	26.4	2.3	
6 SEP 85	24.8	3.6	

a. Blank spaces indicate data not collected.

MISCELLANEOUS DATA COLLECTED BY USABRDL^a (Continued)

Date	Neutralization basin		Aeration basin 5
	Temp., °C	D.O.	Temp., °C
9 SEP 85	25.3	4.1	
10 SEP 85	25.1	3.0	
11 SEP 85	25.4	6.5	
16 SEP 85	22.6	4.0	
20 SEP 85	22.6	2.6	
23 SEP 85	25.7	2.2	
24 SEP 85	22.0	2.7	
7 OCT 85	17.3	3.0	
9 OCT 85	22.4	1.1	
11 OCT 85	24.0	2.4	
22 OCT 85	21.4	1.5	
24 OCT 85	23.1	1.5	
25 OCT 85	23.7	1.2	
31 OCT 85	21.5	1.5	
1 NOV 85	22.0	4.3	
4 NOV 85	19.1	1.5	
12 NOV 85	21.0	1.9	
18 NOV 85	22.3	1.3	
19 NOV 85	22.6	2.6	
3 DEC 85	15.0	0.7	
5 DEC 85	16.7	4.6	
6 DEC 85	14.8	5.2	
12 DEC 85	15.0	4.7	
18 DEC 85	15.6	1.2	
19 DEC 85	14.4	8.1	
17 JAN 86		2.4	13.2
20 JAN 86		2.8	14.2
21 JAN 86		3.5	14.2
22 JAN 86		3.1	13.6
23 JAN 86		3.1	13.8
24 JAN 86		4.1	13.9
27 JAN 86		3.8	11.5
3 FEB 86		3.1	15.2
4 FEB 86		4.2	15.7
6 FEB 86		3.8	15.9
7 FEB 86		3.4	15.7
10 FEB 86		3.8	15.2
11 FEB 86		4.0	13.8
12 FEB 86		4.2	13.9
13 FEB 86		4.8	14.5
14 FEB 86		4.3	10.0
19 FEB 86		4.8	18.2
20 FEB 86		4.1	17.5

a. Blank spaces indicate data not collected.

MISCELLANEOUS DATA COLLECTED BY USABRDL^a (Continued)

Date	Neutralization basin		Aeration basin 5
	Temp., °C	D.O.	Temp., °C
21 FEB 86		4.2	16.6
24 FEB 86		4.4	15.4
25 FEB 86		3.0	15.4
27 FEB 86		4.6	15.8
28 FEB 86		3.6	13.5
3 MAR 86	15.0	5.1	12.0
4 MAR 86	15.0	4.9	12.0
5 MAR 86	14.0	5.2	12.0
6 MAR 86	14.0	5.3	12.0
7 MAR 86	13.0	5.1	12.0
10 MAR 86	16.0	2.7	16.0
11 MAR 86	18.5	4.4	19.0
12 MAR 86	17.5	4.3	19.0
13 MAR 86	18.2	4.4	20.5
14 MAR 86	20.5	4.8	18.0
17 MAR 86	19.5	4.8	18.0
20 MAR 86	18.0	2.9	
21 MAR 86	15.5	4.8	16.0
24 MAR 86	16.2	4.7	15.7
25 MAR 86	21.5	4.6	18.1
26 MAR 86	18.0	4.3	18.2
27 MAR 86	19.0	3.3	19.5
28 MAR 86	18.0		17.5
2 APR 86	20.8	3.4	19.5
3 APR 86	22.5	3.1	21.2
4 APR 86	23.0	3.9	21.4
7 APR 86	23.0	2.6	20.5
8 APR 86	22.0	2.4	21.5
9 APR 86	20.0	2.9	18.0
10 APR 86	21.0	2.7	18.5
11 APR 86	21.0	2.6	20.0
16 APR 86	22.0	3.0	19.2
17 APR 86	22.5	3.0	21.5
18 APR 86	22.0	3.0	20.1
21 APR 86	22.0	2.2	23.6
22 APR 86	21.0	2.9	21.5
23 APR 86	21.5	2.7	18.7
24 APR 86	22.0	3.4	19.0
1 MAY 86	22.5	0.5	23.0
2 MAY 86	21.0	2.8	22.5
5 MAY 86	24.0	1.7	22.0
7 MAY 86	25.0	3.4	20.0
11 MAY 86	26.0	3.3	25.0
13 MAY 86	26.0	3.4	
14 MAY 86	25.0	3.4	
15 MAY 86	26.0	3.5	

a. Blank spaces indicate data not collected.

MISCELLANEOUS DATA COLLECTED BY USABRDL^a (Continued)

Date	Neutralization basin		Aeration basin 5
	Temp., °C	D.O.	Temp., °C
16 MAY 86	26.0	3.2	
19 MAY 86	28.0	2.4	26.0
20 MAY 86	25.5	2.6	25.0
21 MAY 86	25.0	2.8	24.0
22 MAY 86	24.5	2.8	24.0
23 MAY 86	24.5	2.8	24.0
28 MAY 86	25.0	2.7	22.8
29 MAY 86	25.0	2.6	25.4
30 MAY 86	24.0	2.8	23.0
2 JUN 86	27.0	2.8	23.5
3 JUN 86	25.0	2.8	21.5
4 JUN 86	25.0	2.3	21.8
5 JUN 86	27.0	2.7	26.0
9 JUN 86	25.5	2.0	25.4
10 JUN 86	27.0	4.2	25.9
11 JUN 86	26.0	4.1	25.9
12 JUN 86	27.8	2.8	26.0
16 JUN 86	28.0	3.9	26.3
17 JUN 86	29.5	3.1	26.2
18 JUN 86	27.0	4.0	24.6
19 JUN 86	25.0	3.4	24.6
23 JUN 86	27.0	4.8	25.0
24 JUN 86	27.0	3.8	26.0
26 JUN 86	25.0	3.8	25.0
1 JUL 86	27.5	3.8	25.0
2 JUL 86	27.0	3.8	25.2
3 JUL 86	26.0	3.6	25.2
7 JUL 86	26.5	4.4	26.0
8 JUL 86	26.0	4.8	25.5
9 JUL 86	26.0	4.8	26.5
10 JUL 86	25.0	4.8	25.0
11 JUL 86	26.0	5.2	24.0
14 JUL 86	26.0	3.4	26.2
15 JUL 86	28.0	3.3	25.6
16 JUL 86	27.0	3.2	26.0
17 JUL 86	26.0	2.9	25.8
21 JUL 86	27.0	3.3	25.0
22 JUL 86	26.0	3.1	22.0
23 JUL 86	22.0	3.0	26.0
25 JUL 86	26.0	2.8	26.0
28 JUL 86	26.0	2.4	25.5
29 JUL 86	28.0	3.7	24.5
30 JUL 86	26.0	3.0	23.8
31 JUL 86	26.0	2.8	24.0

a. Blank spaces indicate data not collected.

MISCELLANEOUS DATA COLLECTED BY USABRDL^a

Date	Neutralization basin		Aeration basin
	Temp., °C	D.O.	Temp., °C
4 AUG 86	24.0	2.5	24.0
5 AUG 86	26.0	3.4	24.0
6 AUG 86	27.0	2.6	25.2
7 AUG 86	26.0	3.0	25.9
8 AUG 86	26.0	3.8	25.5
11 AUG 86	24.0	3.3	25.6
12 AUG 86	25.0	1.6	24.6
13 AUG 86	27.0	3.6	25.9
14 AUG 86	28.0	3.4	27.0
18 AUG 86	27.0	2.6	28.1
19 AUG 86	29.0	3.3	24.5
20 AUG 86	25.0	3.6	25.0
21 AUG 86	25.0	4.0	24.2

APPENDIX K

DIGESTER DATA COLLECTED BY USABRDL

Date	Total suspended solids g/L	Volatile suspended solids g/L
27 JUN 86	10.19	6.16
1 JUL 86	11.19	6.16
2 JUL 86	11.15	6.07
3 JUL 86	8.69	4.77
7 JUL 86	11.27	6.21
8 JUL 86	11.41	6.32
9 JUL 86	10.98	5.97
10 JUL 86	11.17	6.10
11 JUL 86	11.49	6.36
14 JUL 86	12.33	6.87
21 JUL 86	12.98	7.45
22 JUL 86	13.11	7.54
23 JUL 86	12.49	6.96
24 JUL 86	11.92	6.68
25 JUL 86	12.48	6.97
28 JUL 86	12.65	7.18
29 JUL 86	12.44	7.00
30 JUL 86	12.50	7.10
31 JUL 86	13.46	7.81
4 AUG 86	12.97	7.37
5 AUG 86	10.53	6.01
6 AUG 86	13.20	7.53
7 AUG 86	13.11	7.44
8 AUG 86	13.70	8.01
11 AUG 86	13.81	7.92
12 AUG 86	15.09	9.07
13 AUG 86	14.59	8.82
18 AUG 86	13.60	8.12
19 AUG 86	14.00	8.04
20 AUG 86	15.61	9.23

APPENDIX 1

NITRAMINE ANALYSES

TABLE L1. AREA B MUNITIONS CHEMICALS, MG/L

Date	SEX	HMX	TAX	RDX
10 JUL 85	2.532	2.753	2.706	6.703
25 JUL 85	1.032	3.007	0.445	3.962
11 SEP 85	1.819	2.250	3.795	6.195
12 SEP 85	1.094	2.208	4.976	6.342
19 SEP 85	1.502	2.261	2.096	4.665
20 SEP 85	1.542	2.273	3.973	7.384
23 SEP 85	1.356	2.510	4.036	5.118
24 SEP 85	1.171	2.402	1.710	4.795
25 SEP 85	1.757	2.713	2.703	7.478
30 SEP 85	1.785	2.287	5.604	8.011
1 OCT 85	1.303	2.308	3.694	5.587
2 OCT 85	1.334	2.275	2.385	4.800
3 OCT 85	2.605	2.723	5.599	6.368
7 OCT 85	2.611	2.757	2.278	7.226
8 OCT 85	1.515	2.321	3.554	4.937
9 OCT 85	1.889	2.398	2.472	5.099
10 OCT 85	1.634	1.970	2.782	3.452
11 OCT 85	1.433	1.386	3.738	3.932
14 OCT 85	1.070	1.979	2.872	4.608
15 OCT 85	1.921	2.417	3.350	6.369
16 OCT 85	2.210	2.190	6.689	7.952
21 OCT 85	0.401	1.654	1.412	10.397
22 OCT 85	0.809	1.821	0.130	5.262
31 OCT 85	2.016	2.260	2.301	5.022
1 NOV 85	1.030	1.842	1.936	3.419
4 NOV 85	1.523	1.809	1.653	4.102
5 NOV 85	1.867	2.009	4.484	6.766
12 NOV 85	2.057	2.211	6.412	7.001
14 NOV 85	1.517	2.002	3.240	5.463
15 NOV 85	1.865	2.283	4.303	8.143
18 NOV 85	3.648	2.723	5.272	9.755
19 NOV 85	3.781	2.659	6.228	9.756
3 DEC 85	1.375	1.771	2.311	5.084
6 DEC 85	1.102	1.751	1.785	4.557
28 JAN 86	1.828	1.476	4.630	6.442

TABLE L2. NEUTRALIZATION BASIN MUNITIONS CHEMICALS, MG/L

Date	SEX	HMX	TAX	RDX
7 JUN 85	2.315	2.319	2.932	3.882
20 JUN 85	2.124	2.073	3.752	4.356
25 JUN 85	2.636	1.748	4.185	6.057
27 JUN 85	2.275	2.944	3.502	4.184
10 JUL 85	1.327	1.980	2.473	5.182
25 JUL 85	0.958	1.565	1.060	3.188
22 AUG 85	1.785	1.663	0.882	4.880
23 AUG 85	1.358	1.724	1.822	4.356
26 AUG 85	0.534	1.466	1.272	2.633
26 AUG 85	1.396	2.090	1.798	10.074
27 AUG 85	1.930	2.072	1.358	6.378
28 AUG 85	2.848	1.728	1.527	4.606
29 AUG 85	1.233	1.766	3.410	3.602
4 SEP 85	1.090	1.760	2.364	7.427
5 SEP 85	1.974	1.713	4.616	6.298
9 SEP 85	0.404	1.949	1.427	3.339
10 SEP 85	0.823	1.350	1.626	3.246
11 SEP 85	1.910	1.861	2.660	4.751
12 SEP 85	0.806	1.734	3.737	4.747
16 SEP 85	1.419	2.309	3.451	4.302
20 SEP 85	0.789	2.016	1.655	3.989
23 SEP 85	1.024	2.016	2.792	3.444
24 SEP 85	1.301	2.273	2.005	4.211
25 SEP 85	1.046	1.813	1.762	3.498
30 SEP 85	1.690	2.126	3.569	2.646
1 OCT 85	1.303	2.308	3.594	6.587
2 OCT 85	1.239	1.771	2.301	3.624
3 OCT 85	1.589	1.988	4.648	6.922
7 OCT 85	1.295	1.979	2.548	5.186
8 OCT 85	0.732	1.717	2.835	3.649
9 OCT 85	1.331	1.937	1.861	3.369
10 OCT 85	1.257	1.920	1.837	3.023
11 OCT 85	0.67	1.896	2.706	2.244
14 OCT 85	1.256	1.792	3.421	5.114
15 OCT 85	1.531	1.876	3.059	6.082
16 OCT 85	1.319	1.928	3.026	4.157
21 OCT 85	0.376	1.659	1.163	9.870
22 OCT 85	2.657	1.665	<0.070	4.248
31 OCT 85	1.529	1.999	1.219	4.334
1 NOV 85	0.950	1.732	1.818	3.063
4 NOV 85	0.962	1.624	1.355	3.271
5 NOV 85	1.662	1.440	<0.070	1.990
12 NOV 85	1.620	1.590	3.645	5.179
14 NOV 85	1.220	1.667	2.553	3.870
15 NOV 85	1.342	1.633	3.339	5.097
18 NOV 85	2.656	1.985	3.723	6.427
19 NOV 85	0.815	1.740	1.732	4.521
3 DEC 85	1.136	1.221	1.710	4.655

DATE	SEX	HMX	TAX	RDx
6 DEC 85	0.978	0.255	0.995	2.414
16 DEC 85	1.625	1.351	4.555	5.221
18 DEC 85	2.328	1.602	3.214	6.104
19 DEC 85	1.294	1.295	3.905	5.269
1 JAN 86	0.957	1.148	3.246	6.605
21 JAN 86	2.436	1.413	0.101	3.793
22 JAN 86	3.540	1.536	4.401	5.534
23 JAN 86	1.381	1.367	3.593	5.858
24 JAN 86	1.162	1.112	2.302	6.277
27 JAN 86	1.677	1.167	1.359	3.067
28 JAN 86	1.579	1.072	2.793	4.236
3 FEB 86	2.238	1.343	3.934	4.569
4 FEB 86	1.248	1.498	2.565	4.727
6 FEB 86	1.615	1.580	2.261	4.350
7 FEB 86	2.032	1.632	2.873	3.568
10 FEB 86	2.213	2.017	4.845	6.420
11 FEB 86	0.797	1.560	3.280	4.799
12 FEB 86	1.173	1.742	3.435	4.781
13 FEB 86	1.775	1.344	4.279	4.757
14 FEB 86	2.528	1.702	3.884	5.983
19 FEB 86	0.401	1.012	1.040	3.900
20 FEB 86	1.820	1.214	2.278	4.356
21 FEB 86	0.724	0.999	1.845	5.168
25 FEB 86	1.780	0.765	3.239	4.888
26 FEB 86	2.129	1.296	2.170	5.904
27 FEB 86	3.372	1.373	2.300	5.212
3 MAR 86	0.211	2.006	3.081	2.917
4 MAR 86	0.759	1.052	4.640	4.398
5 MAR 86	0.686	0.916	3.496	4.144
6 MAR 86	0.751	1.250	3.749	5.014
7 MAR 86	1.108	1.303	3.453	6.940
10 MAR 86	1.752	1.613	4.032	6.975
11 MAR 86	2.043	2.003	4.519	6.701
12 MAR 86	1.009	0.803	4.709	9.718
13 MAR 86	1.787	2.148	4.222	7.125
14 MAR 86	1.841	2.027	2.827	5.488
17 MAR 86	1.209	1.592	1.458	3.521
20 MAR 86	2.691	1.838	1.946	6.384
21 MAR 86	1.033	1.440	1.683	1.940
24 MAR 86	2.234	1.807	3.891	5.280
25 MAR 86	1.770	1.827	3.499	7.792
26 MAR 86	1.827	1.609	2.901	5.752
27 MAR 86	1.288	1.709	3.622	4.683
28 MAR 86	1.579	1.854	3.026	5.800
2 APR 86	1.931	1.847	4.122	5.100
3 APR 86	2.240	1.682	2.275	3.911
4 APR 86	2.354	1.990	4.637	6.754
7 APR 86	0.892	1.550	2.617	3.476
8 APR 86	1.590	2.112	2.025	5.477
9 APR 86	2.187	1.912	2.793	6.365
10 APR 86	1.544	2.193	4.052	6.692

DATE	SEX	HMX	TAX	RDX
11 APR 86	1.378	2.271	4.594	6.969
16 APR 86	3.282	1.990	3.329	6.407
17 APR 86	1.860	2.103	3.820	5.675
18 APR 86	2.145	2.208	3.360	5.195
21 APR 86	1.899	2.416	3.514	6.679
22 APR 86	1.994	2.723	1.906	5.897
23 APR 86	1.922	2.524	1.546	4.308
24 APR 86	2.993	2.678	1.629	4.599
25 APR 86	2.014	2.316	<0.070	0.970
1 MAY 86	2.604	1.749	0.116	0.801
2 MAY 86	1.419	2.208	<0.070	1.776
5 MAY 86	1.845	2.127	1.466	0.772
6 MAY 86	1.528	2.287	2.876	3.822
7 MAY 86	2.445	2.576	2.509	6.833
11 MAY 86	3.241	2.522	6.132	6.502
13 MAY 86	1.401	2.357	2.866	6.768
14 MAY 86	3.138	2.467	0.552	4.350
15 MAY 86	2.320	2.299	5.228	6.733
16 MAY 86	2.413	2.794	2.910	5.688
19 MAY 86	2.576	2.995	3.660	4.186
20 MAY 86	3.785	2.848	1.495	3.765
21 MAY 86	2.379	2.691	0.493	2.897
22 MAY 86	1.398	2.762	2.627	0.439
23 MAY 86	1.087	2.616	1.687	0.732
28 MAY 86	1.156	1.889	2.465	3.932
29 MAY 86	1.074	1.738	1.686	2.699
30 MAY 86	1.023	1.886	1.602	2.206
2 JUN 86	1.561	2.551	4.408	5.385
3 JUN 86	0.361	1.805	0.307	3.240
4 JUN 86	1.458	2.063	1.886	5.306
5 JUN 86	1.807	2.138	4.165	5.928
9 JUN 86	0.968	1.755	4.796	5.857
10 JUN 86	1.047	1.605	4.710	6.615
11 JUN 86	0.575	1.433	2.740	4.530
12 JUN 86	0.610	1.777	1.662	4.139
16 JUN 86	1.225	2.259	2.550	4.563
17 JUN 86	2.810	2.472	4.655	5.131
18 JUN 86	2.714	2.669	2.275	6.404
23 JUN 86	1.893	2.619	3.619	3.941
24 JUN 86	1.697	3.132	1.863	2.955
26 JUN 86	2.984	3.061	3.697	4.180
27 JUN 86	1.022	3.291	3.045	5.072
1 JUL 86	0.926	3.244	1.306	5.299
2 JUL 86	1.905	2.478	3.704	5.146
3 JUL 86	0.825	2.371	2.711	6.955
7 JUL 86	1.494	2.773	3.906	6.916
8 JUL 86	1.596	2.659	3.767	4.953
9 JUL 86	1.561	2.671	4.996	9.529
10 JUL 86	0.698	2.178	1.502	6.809
14 JUL 86	1.405	3.019	3.496	7.306
15 JUL 86	1.456	2.847	3.024	5.039

DATE	SEX	HMX	TAX	RDX
16 JUL 86	2.393	3.720	2.751	7.472
17 JUL 86	1.918	3.141	2.599	7.977
21 JUL 86	1.311	2.904	0.790	3.381
22 JUL 86	1.052	2.792	0.101	7.727
23 JUL 86	1.525	0.817	0.010	6.069
24 JUL 86	0.866	3.248	0.012	5.324
25 JUL 86	0.578	2.463	0.577	3.667
28 JUL 86	2.267	4.854	4.592	1.173
29 JUL 86	1.675	2.455	2.135	5.247
30 JUL 86	1.602	3.398	3.089	6.832
31 JUL 86	1.387	2.897	1.712	4.731
4 AUG 86	1.397	0.504	3.326	3.366
5 AUG 86	1.165	0.514	2.616	4.462
6 AUG 86	1.225	1.984	2.612	3.536
7 AUG 86	1.321	0.562	2.154	3.121
8 AUG 86	1.378	0.843	3.894	3.922
11 AUG 86	1.252	1.532	2.427	3.940
12 AUG 86	0.850	1.861	1.303	2.407
13 AUG 86	1.621	2.345	2.087	4.668
14 AUG 86	2.072	2.842	1.925	5.557
18 AUG 86	1.115	2.220	2.190	3.523
19 AUG 86	2.183	2.588	1.364	4.820
20 AUG 86	1.736	1.951	3.211	4.582
21 AUG 86	1.586	2.391	2.547	4.244

TABLE L3. ANOXIC FILTER EFFLUENT MUNITIONS CHEMICALS, MG/L

Date	SEX	HMX	TAX	RDX
10 JUL 85	0.821	1.524	1.291	3.295
25 JUL 85	0.101	0.111	0.576	1.284
11 SEP 85	0.449	0.915	1.723	1.279
12 SEP 85	0.089	0.509	1.952	0.674
19 SEP 85	0.586	1.002	1.157	0.952
20 SEP 85	0.361	0.960	0.970	1.156
24 SEP 85	0.805	0.696	2.507	2.005
25 SEP 85	<0.070	0.278	0.231	0.095
30 SEP 85	1.199	2.094	2.715	0.623
1 OCT 85	0.200	0.352	0.811	<0.070
2 OCT 85	0.272	0.558	1.781	0.844
3 OCT 85	0.927	1.150	2.361	0.632
7 OCT 85	1.136	1.775	2.254	2.717
8 OCT 85	0.874	1.709	2.441	1.533
9 OCT 85	<0.070	<0.070	0.083	<0.070
10 OCT 85	0.927	1.790	1.712	2.136
11 OCT 85	0.764	1.405	2.209	0.806

Date	SEX	HMX	TAX	RDX
14 OCT 85	0.596	1.071	0.623	0.140
15 OCT 85	0.950	1.475	2.093	1.756
16 OCT 85	0.476	1.005	0.811	<0.070
21 OCT 85	0.123	1.388	0.264	0.138
22 OCT 85	1.196	1.428	<0.070	2.477
31 OCT 85	2.127	0.822	0.973	1.413
1 NOV 85	2.142	0.842	1.511	1.475
4 NOV 85	1.788	1.368	1.301	1.058
5 NOV 85	1.922	1.222	2.055	2.528
12 NOV 85	1.815	1.219	2.330	2.534
14 NOV 85	1.784	1.036	1.502	0.962
15 NOV 85	1.241	1.035	1.195	1.360
19 NOV 85	2.670	0.930	1.142	2.275
3 DEC 85	1.062	0.776	1.751	0.923
14 DEC 85	2.752	<0.070	1.184	1.185
15 DEC 85	4.301	<0.070	2.184	1.185
16 DEC 85	10.906	0.605	3.923	1.628

TABLE L4. FINAL EFFLUENT MUNITIONS CHEMICALS, MG/L

Date	SEX	HMX	TAX	RDX
10 JUL 85	1.002	1.470	<0.070	3.541
25 JUL 85	0.819	1.782	<0.070	2.282
11 SEP 85	0.459	1.431	<0.070	2.190
12 SEP 85	0.661	1.495	<0.070	2.486
19 SEP 85	0.689	1.841	<0.070	2.593
20 SEP 85	0.632	1.759	<0.070	2.859
23 SEP 85	0.517	1.695	<0.070	2.629
24 SEP 85	0.450	1.648	<0.070	2.556
25 SEP 85	0.547	1.565	<0.070	2.334
30 SEP 85	0.595	1.709	<0.070	2.582
1 OCT 85	0.545	1.768	<0.070	2.603
2 OCT 85	0.662	1.687	0.108	2.888
3 OCT 85	0.703	1.931	<0.070	2.693
7 OCT 85	0.780	1.788	<0.070	1.534
8 OCT 85	0.648	1.563	<0.070	2.888
9 OCT 85	0.681	1.768	<0.070	3.121
10 OCT 85	0.788	1.858	<0.070	2.802
11 OCT 85	0.645	1.786	<0.070	2.300
14 OCT 85	0.596	1.850	<0.070	2.840
15 OCT 85	0.735	1.846	<0.070	2.935
16 OCT 85	0.757	1.468	<0.070	2.711
21 OCT 85	0.526	1.541	<0.070	3.488
22 OCT 85	0.282	1.475	<0.070	2.675
31 OCT 85	2.594	0.967	<0.070	1.914

Date	SEX	HMX	TAX	RDX
1 NOV 85	2.163	0.996	<0.070	1.712
4 NOV 85	2.067	1.457	<0.070	2.215
5 NOV 85	1.682	1.440	<0.070	1.990
12 NOV 85	2.029	1.063	0.214	2.708
14 NOV 85	1.708	1.642	0.337	2.540
15 NOV 85	1.907	1.487	0.179	2.567
19 NOV 85	2.096	1.277	<0.070	1.708
3 DEC 85	1.648	1.306	0.281	2.241
6 DEC 85	2.475	1.367	0.129	3.201
14 DEC 85	3.707	1.531	<0.070	3.099
15 DEC 85	5.205	1.860	<0.070	3.903
16 DEC 85	3.354	1.131	<0.070	2.513
18 DEC 85	3.702	1.169	<0.070	2.789
19 DEC 85	3.104	1.124	<0.070	2.791
3 MAR 86	0.765	1.291	<0.070	2.268
4 MAR 86	0.435	1.294	<0.070	2.350
5 MAR 86	0.441	1.309	<0.070	2.874
6 MAR 86	0.528	1.229	<0.070	3.142
7 MAR 86	0.697	1.191	<0.070	3.130
13 MAY 86	1.127	2.242	<0.070	3.609
14 MAY 86	0.872	2.258	<0.070	3.106
15 MAY 86	0.929	2.189	<0.070	2.272
16 MAY 86	0.999	2.120	<0.070	2.484
11 AUG 86	0.700	1.183	<0.070	1.801
12 AUG 86	0.710	0.991	<0.070	2.008
13 AUG 86	0.672	0.910	<0.070	1.734
14 AUG 86	0.586	0.954	<0.070	1.777
18 AUG 86	0.717	1.285	<0.070	1.822
19 AUG 86	0.709	1.255	<0.070	1.805
20 AUG 86	0.660	1.115	<0.070	1.761
21 AUG 86	0.642	0.835	<0.070	1.886
22 AUG 86	0.526	0.851	<0.070	1.855

APPENDIX M

GLOSSARY OF TERMS

BOD	Biochemical oxygen demand
BOD ₅	Five-day biochemical oxygen demand
USABRDL	U.S. Army Biomedical Research and Development Laboratory
COD	Chemical oxygen demand
DO	Dissolved oxygen
F/M	Food-to-microorganism ratio
gpd	Gallons per day
gpm	Gallons per minute
HDC	Holston Defense Corporation
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	High performance liquid chromatography
HSAAP	Holston Army Ammunition Plant
k _{BOD}	Specific rate of BOD utilization
mgd	Million gallons per day
MLSS	Mixed liquor suspended solids
MLVSS	Mixed liquor volatile suspended solids
NH ₃ -N	Ammonia nitrogen
NO ₂ -N	Nitrite nitrogen
NO ₃ -N	Nitrate nitrogen
NPDES	National Pollutant Discharge Elimination System
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
S ₀	Influent total BOD ₅
S _e	Effluent soluble BOD ₅
SEX	1-Acetyloctahydro-3,5,7-trinitro-1,3,5,7-tetrazocine
SVI	Sludge volume index
TAX	1-Acetylhexahydro-3,5-dinitro-1,3,5-triazine
TSS	Total suspended solids
X _v	Biomass (usually = MLVSS)
θ	Sludge age

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